STUDIES IN FEMALE LABOUR SUPPLY: EGYPT

AMAL SANAA SOLIMAN

A Thesis submitted for the Degree

of Doctor of Philosophy

The City University, London.
Department of Actuarial Science and Statistics
School of Mathematics

February 1989

To God,
and my Parents.

TABLE OF CONTENTS

EFS	Egyptian Fertility Survey
E£	Egyptian Pound
LFS	Labour Force Sample Survey
OPEC	Organisation of Petroleum Exporting Countries

Acknowledgements

I wish to express my deep appreciation and total gratitude to my Supervisor, Professor Bernard Benjamin, for his understanding, encouragement, patience and constructive suggestions.

I wish to thank the Central Agency for Public Mobilisation and Statistics for provision of the data which enabled me to carry out this research.

I also wish to thank Mr. Galal Ismail for all his constructive help and support, the University of London Computer Centre for help from their advisory unit, especially, Mr. David Tilley and Mr. Alan Hume. My thanks and gratitude are also extended to Samantha for her skillful typing of the manuscript.

Personal appreciation for their kindness and supportive roles is given to my parents and brother. This also extended to my relatives of whom I should mention my uncles, Dr. Ahmed Shafik and Mr. Ragaa el-Hady for helping me to obtain the data, my cousin, Mona, Aunt and Grandmother; and friends; especially Anne for her constant support, Norma, Dr. El-Qadi, Dr. Mirza, Dr. Muweza, Dr. Khalil, Osama Abdel-Latif and Carol Allen.

Abstract

The thesis consists of empirical analysis of the labour supply behaviour of married and single females in Egypt, using data from the 1984 LFS, 1980 EFS and 1976 Census.

A utility maximisation approach, in which leisure time and consumption goods represent the choice faced by individuals, is used to determine work behaviour. The nature of the labour force participation decision is examined and a model is presented based on the comparison of the market wage and own wage functions. Finally, the time-allocation model, which incorporates non-working time, is presented and other household decisions, such as the determination of family size are brought into the sphere of analysis.

The results obtained using aggregated data indicate that educational attainment and family size and composition are the major determinants of labour supply. Wage and income elasticities are small. And, overall, a higher unemployment rate creates a discouraged-worker effect for married females and an added-worker effect for single females. Similar results are obtained using individual data for Cairo, though there exists a discouraged-worker effect for all marital status groups and the income level is found to exert a positive effect contrary to theoretical expectation.

The use of a framework where household decisions are jointly determined is tested using two simultaneous-equation models. One of the conclusions reached is that mothers with higher wage and educational levels are in occupations least compatible to child-rearing and so have lower fertility levels. The results also indicate that completed rather than current fertility levels is a better determinant of the decision of a female to work.

CHAPTER I INTRODUCTION

The processess of economic development generally involves the transfer of production from small self-sufficient units; the household or family; to more specialised production units; factory or firm. With economic development, the shift towards the exchange of goods and services through the market economy has often resulted in the loss of female economic participation(1).

The economic role of females in Egypt has followed this pattern; a pattern witnessed in many developing countries. In the beginning of the nineteenth century, females formed an important part of the labour force(2). They were engaged mainly in unskilled jobs; working in the textiles or food industries. In towns and cities females also worked as shop assistants, midwives, servants and cotton workers.

The move towards industrialisation and urbanisation restricted female employment. And, since the beginning of this century, female activity rates have been declining. However in the 1970-80 decade, there has been a sharp increase in the activity rate. It rose from a figure of 5.5% (1976 census), a representative figure for the 1970's decade, to 13.8% (as measured by the LFS) in 1984(3). The economic participation of Egyptian females needs to be explained.

The theory used to explain the labour force behaviour of females is the neoclassical theory of choice and utility maximisation(4). This framework is also used to explain many aspects of household behaviour including the decision to bear children. Reid (1934) and

Robbins (1930) laid the foundations on which Becker (1965, 1981) developed a theory of time allocation and later a general theory of household decision making. A number of empirical studies have been used to test the neoclassical model, both in developed and developing countries(5).

Schultz (1974) in reference to fertility behaviour examines the suitability of the household model in low-income countries, where the economic value of human time is low. He percieves the main difficulty not in the inability of the model to explain behaviour, but rather in the different and greater economic role households perform in low income countries. Among the differences is the observation that childcare is not the sole responsibility of the mother in less-developed countries and, in addition, market work and childcare are complementary rather than alternative uses of time in the traditional sector(6). In specific reference to labour supply, the model tests the responsiveness of labour supply to changes in wages and income. In less developed countries a large informal sector operates in the labour market thus weakening the emphasis on wages in the model(7).

The aim of this study is to examine the labour force behaviour of females in Egypt using an econometric framework based on the neoclassical model of choice. Apart from the intrinsic value of the theoretical and empirical study of female labour supply, it is essential, before developing direct and indirect policy interventions to influence female work behaviour, to study the type of work females are engaged in and what factors influence their economic activity(8).

Policy formulation requires knowledge of the effect of economic variables (these include wages and other income) on the work behaviour of the individual. In addition, the possible understanding of the effect of non-economic variables, such as education and family size, on the decision to work would also prove useful in the relevant areas of policy making.

The empirical analysis presented in this study uses cross-section survey data collected in Egypt in 1984 (LFS) and in 1980 (EFS), and the 1976 Census.

Two main demographic groups are studied: adult married females and adult single females. The analysis is applied to individual data and aggregate data. Labour supply is measured by the decision to participate in the labour force and hours worked.

This thesis is organised in six chapters including the introduction. The following is a brief description of the contents of each chapter.

In Chapter II, a description of the major features of the Egyptian labour market and labour force is presented, which serves to provide a necessary background for the subsequent analysis of the results. First of all, the characterisation of Egypt as a country having a labour-surplus economy is considered. The nature of the Egyptian labour market is one in which there has been an expanding public sector and government intervention in employment and wage policy. External migration to oil-producing Arab countries has also become a main feature. Next, the trend in the labour force participation of females is examined, although the information is

unavailable of the rates by marital status. A number of developments which have influenced the female labour force are considered.

In Chapter III, the theoretical framework adopted in this thesis is presented. A utility function consisting of two commodities, leisure time and consumption goods, with a budget and time constraint is maximised. Following conventional consumer analysis, a demand function for leisure is derived from which a supply function of labour is obtained. Next, a model is developed to explain the decision to participate in the labour market. The participation decision is based on the comparison between the market wage and own wage. A two equation model is then proposed for the purpose of estimation. The first function, the offered wage function, is estimated using least squares while the second function, the probability of participation function is estimated using probit analysis. The own wage function is derived from the two equations referred to earlier. A statistical problem in the estimation procedure is also discussed; the selection bias that arises from using a sample of workers. A correction is proposed. Finally, the relationship between female work and other household decisions (such as bearing children) is examined through the time allocation model, and, the major determinants on female market participation are presented.

In Chapter IV, the differences in the work behaviour of females between the governerates of Egypt is analysed. A reduced-form participation function, hours of workers function and hours of all females function are estimated using least squares regression. The analysis uses aggregated cross-section data from two data sources;

the 1984 LFS and published data from the 1976 census. The results indicate that educational attainment and to a lesser extent family size and composition are the major determinants of labour supply. The responsiveness of labour supply to wages and income is weak. It would also appear that, overall, the unemployment rate in a governerate creates a discouraged-worker effect for married females and an added-worker effect for single females.

In Chapter V two approaches used to examine the labour force behaviour of females on the individual level are applied. The first approach is based on the comparison between offered and asking wage functions. A number of hypotheses are examined within this framework. It is found that using a sample of workers for the estimation of the wage and hours does not produced biased coefficient estimates. The results also indicate that females who have a greater probability of working are also more likely to work longer hours. Educational attainment is found to be an important factor, but wage elasticities are very small (being greatest in magnitude for divorced females). The level of income provides results that are in contrast with the theory. Unemployment exerts a discouraged-worker effect for all marital status groups. Finally, family size and composition are also important determinants of labour supply; the presence and number of children aged less than three years is significant for the participation decision whereas school-age children (6-11 years) exert an effect on working mothers.

The aim of the second approach is to examine the relationship between labour force participation and fertility decisions in a framework were these household decisions are jointly determined. Two models are presented and empircally tested. The first is a four

equation system in which the endogeneous variables are determined by the same set of exogeneous variables. One of the conclusions reached is that mothers with higher wages and higher education levels are in occupations which are less compatible with child-rearing and so reduce fertility levels. The level of schooling for the husband and possession of an asset are found to be the most straight forward variables in interpretation when considering the income effect on fertility levels. The second model considered is a two equation recursive system: completed fertility levels are assumed to determine current and lifetime labour force participation. Although the hypothesis might not be totally correct, the use of an imputed equation for the number of children born provides statistically significant coefficient estimates, which is not the case when the actual number of children is used.

In Chapter VI, a summary and comparison of results with those obtained from other studies, when applicable, is presented. The results, in nearly all cases, are in agreement with theoretical expectations. The existing data sets provide good results to the models adopted.

NOTES

(1) The role of females in economic urban development is described in Boserup (1970, 1981) and Schultz, (1981).

(2) This historical account is described in greater detail in Ibrahim (1985).

(3) It would be of interest to dissect the increase in the rate by different marital status, but data are not available. Reasons for this increase are discussed in Chapter II.

(4) The full development of the theory is presented in Chapter III. Neo-classical economics is characterised by micro-economic theoretical systems in contrast to the macro-economic approach of other economic systems (e.g., Keynsian).

(5) Studies include those of Mincer (1962), Bowen & Finegan (1969), Cain and Watts (1973) on US data. Studies using British data include Greenhalgh (1977), Layard, Barton and Zabalza (1980). Studies on less-developed countries include those of Okojie (1985), D'Oliveira (1978) and McCabe & Rosenzweig (1976), Khandber (1987).

(6) Okojie (1985) develops this arguement in more detail.

(7) Criticism of the model even when applied to developed countries lies in the structure of neo-classical theory itself. Freedom of choice might be an unreasonable assumption, it is "a-historical and a-social", Amsden (1980). The analysis needs other research areas for clarification. An example of this is given by the analysis of wages on labour supply. Theory predicts that changes in wages can have two opposite effects on labour supply; an income effect and substitution effect, but does not explain why one effect should dominate. Historical analysis is then needed to explain the rise in female economic participation; altered parental-child relationships and a change in values brought about by changes in prices and income, puts "flesh on the skeleton" (Amsden, 1980; p.30) of the income and substitution effects.

(8) A number of articles describe the extent and diversity of female work in Shorter and Zurayk (1985).

CHAPTER II: THE EGYPTIAN LABOUR MARKET AND LABOUR FORCE

2.1 The Employment Problem

The 1976 census estimated the population of Egypt to be 38.2 million. The main trends in population size and the major components of population growth are shown in table (2.1). The figures indicate a gradual decline in the mortality rate, with a sharp decline in infant mortality. The trend in fertility rates has not been constant. A decline in the rate during the mid-seventies was reversed, and the birthrate has remained just below 40 births per thousand in the population. The rates, though in accordance with other countries at Egypt's level of economic development, are still high[1]. These trends have resulted in a rate of natural increase that has reached nearly 3%.

Egypt's main resource is the alluvial soil of the Nile Valley and Delta; the Nile making Egypt one of the oldest agrarian societies in history. The rural labour force represented 65% of the total labour force in 1960 and 56% in 1976 (1976 census figures). The agricultural labour force represented 56% of the total labour force in 1960 and 44% in 1976 (1976 census figures). These figures indicate a transfer of the labour force from rural areas and agricultural activity to urban areas and industrial activity.

Table 2.1 Population size and indices for Egypt, 1960-84

Year	Birth rate	Mortality rate	Rate natural increase	Infant mortality	Population size (000s)
1960	42.9	16.9	26.0	168[a]	26,085
1966	40.9	15.8	25.1		30,188
1976	36.6	11.8	24.8	116[a]	38,198
1977	37.5	11.8	25.7		38,794
1978	37.4	10.5	26.9		39,767
1979	40.2	10.9	29.3		40,889
1980	37.5	10.0	27.5	132[b]	42,126
1981	37.3	10.4	26.9		44,673
1983	37.6	10.0	27.6		45,915
1984	38.4	9.4	29.0		47,191

Rates per thousand population

Source: Statistical Yearbook 1985: Arab Republic of Egypt

(a) Source: Seatheram (1983)
(b) Source: 1980 EFS (for females aged 15-49 years)

The predominance of the agricultural sector (though this is no longer the case) led to the characterisation of Egypt as a country having a labour-surplus economy [2]; that is, one in which labour in the traditional (agricultural) sector is considered an abundant, unproductive asset. It has been argued that by moving agricultural labour into the modern industrial sector, industrial output will rise without any loss in agricultural output. This assumes that the marginal productivity of agricultural labour is zero or close to zero[3]. Development economists have thus argued that, with the available capital in the industrial sector, the success of economic growth would only depend on the labour reallocation process, i.e., through rural-urban migration[4].

The experience of less-developed countries, including Egypt, shows that the labour-surplus hypothesis is addressing a different problem. Capital-intensive techniques imported from more developed countries, which were thought to be favourable to the development process (smaller wage bills means higher profits which can be re-invested), have only aggravated a situation where the work-force was fast increasing through high rates of population growth.

The problem faced is not one of labour reallocation, but one of employment and job creation for the ever-increasing work force.

Table 2.2 Size and growth of the labour force and dependant population

Table 2.2a

	Population Size (000s)		Proportion of the Population	
	Year		Year	
Age Group	1960	1976	1960	1976
-15	11077.3	145599.1	.43	.40
15-64	13871.6	20604.4	.54	.56
65+	891.4	1301.4	.03	.04

Source: Yearbook of Labour Statistics

Table 2.2b

Year	Size of labour force (000s)	Dependency Ratio	Young-age Dependency	Old-age Dependency	Effective Dependency
1960	7832	.85	.79	.055	1.53
1976	11132	.79	.71	.07	1.43

To illustrate the problem of job-creation, figures from table (2.2) indicate that the size of the work force has increased by nearly 50%. The dependency ratio is declining, (.85 to .71) showing a decrease in young-age dependency plus a slight increase in old-age dependency. However, only 56% of those aged 15-64 were economically active in 1960 and 54% in 1976. The effective dependancy rate is then 1.53 in 1960 and 1.43 in 1976. The problem of population growth then, it would seem, lies in the difficulty of job-creation for the work force rather than the provision of support for dependants. (Although it is simultaneously not a dependancy problem in the sense that the unemployed are dependant).

The remaining part of the Chapter is concerned with a brief description of the labour market and labour force in Egypt.

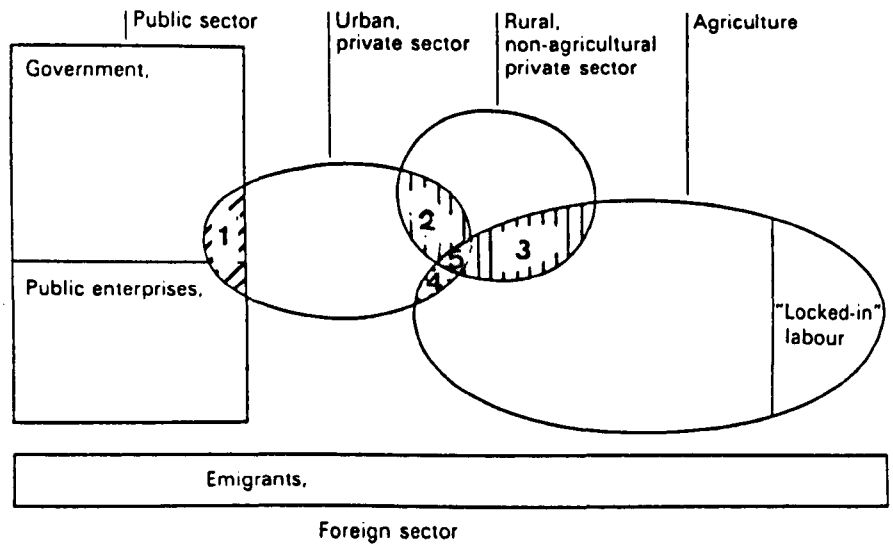
2.2 The Egyptian Labour Market

Egypt lies in the desert belt which stretches across the northern hemisphere from the Atlantic Ocean through Arabia to China. The area of Egypt is one million square kilometres, but less than 5% (35,580 sq. Km) of the country, mainly along the Nile Valley, is habitable. Consequently, the density of the inhabited area is high, about 1000 per square kilometre (1976 census). "The most striking feature of Egypt's urban and rural areas is that both are crowded. Not only do cities and towns have high population densities, but the country-side is dotted with closely spaced villages, many large enough to count as small towns in other countries". (Ikram (1980) : p.105).

The expansion of agricultural employment is constrained by the limited amount of cultivable land as well as the existing labour-intensive nature of the agricultural technology in use[5]. A study by Mohieldin[6] addressed the labour-surplus problem in rural Egypt. The study locates the surplus labour on small farms (less than five feddans[7] which have a surplus of man-labour, while large farms in the same region can suffer from a shortage of woman and child labour. Thus, to characterise the rural labour market as a labour-surplus one is too general a description. Also, although half the total work force is located in rural areas, over half the money income of the rural population is derived from non-agricultural activities. It seems that there is a large rural non-agricultural sector. The movement between these sectors and other sectors in the Egyptian labour market is shown in figure (2.1)[8]

During the late 1950s and 1960s, growing government intervention in the economy led to the expansion of the government and public sector. The government and public enterprise sectors employed nearly 27% of the total labour force (1976 census) while the private sector share was nearly 73%. According to Hansen & Radwan (1982, p.62), the corresponding government share of employment was less than 10% in 1960. The large increase is due to the intervention policies which included nationalisation and employment-generating policies which guaranteed employment for graduates of higher education institutes. However, the later policy has resulted in overstaffing of the public sector and a strong bias towards University education leading to an excess supply of people with an academic education[9].

Figure 2.1 The intersection of submarkets in the Egyptian labour market



(1) On the family level, this represents some family members working in the public and others in the private sector.

On the individual level, these represent public sector employees with second jobs in the private sector. In principle, this is illegal except with permission. However, this seems to occur on a large scale and the Labour Force Survey (LFS) does not cover this aspect of the labour force (which is very important for measuring the number of hours supplied by an individual). This source of confusion is probably a factor in all economies.

(2) Commuters, seasonal movement of labour:-

(3) Farmers shifting seasonally between agricultural and non-agricultural activities.

(4) Mainly agricultural labours working as unskilled labour on construction sites or small farmers in inter-sectorial trade and transportation.

(5) "Traheel" workers - a group of particularly mobile workers.

Source: Hansen & Radwan (1982) : pp.143-146.

Wage determination in the public sector is also linked to the educational attainment of the employee. Each educational level has a basic wage rate, which is set, and which can be supplemented by overtime pay, bonuses and incentives[10]. On the whole, however, the wage scale system of the public sector lacks flexibility[11]. Private sector wages are mainly determined by market forces. Again, there is a degree of government intervention : the imposition of minimum wages during the sixties and a cost of living allowance in the seventies has meant that wages in the private sector are not totally determined by market forces. According to Korayem (1984, p.73), there is also an indirect impact on private sector wages by the wage schedule set in the public sector. Wages set in the private sector take the public sector wage level into account.

External migration has become one of the most important characteristics of the Egyptian labour market, especially since 1973. The destination of the migrants is mainly the Arab OPEC countries where their stay is of a temporary nature. Although, most of the migrants before 1973 were teachers, scientists or from the technical professions, emigration is now dominated by construction and unskilled workers[12]. The total volume of emigration is a point of debate; the 1976 census estimated that there were around one million Egyptians, i.e. 9% of the total labour force working abroad (a figure that is considered too high), while other sources estimate the proportion at under 4%[13].

2.3 The Egyptian Labour Force[14]

The total labour force in Egypt increased by 42% from 1960 to 1976 (7.8 million to 11.1 million), with 64% of the total increase

in urban areas (table 2.3).

The size of the female labour force declined from 897 thousands in 1937 to 614 thousands in 1960 rising again to 988 thousands in 1976. Female participation rates show a similar trend declining from 11.3% in 1937 to the lowest value of 4.8% in 1960 after which there was a gradual increase to 5.5% in 1976, with a rapid increase in the rate at the beginning of the 1980 decade: see the LFS trend, table (2.4). However, the increase since 1983 can be partly related to changes in the enumeration of females in the labour force.

However, while the growth rate for the female labour force was high, the share of females in the total labour force still amounted to 9% in 1976 (calculated from table 2.3). Most of the increase in the labour force has been due to population growth. However, for females, especially in the urban areas, the increase in activity rates accounted for 51% of the increase.

Inspite of this increase, a cross-national comparison of female activity rates (table 2.5) reveals that the Egyptian rate is certainly one of the lowest in the world at 5.5%. The participation rate for those aged over fifteen years is 6.4%. Traditional, cultural or religious barriers could be important factors. Other Arab Islamic countries have low activity rates(15).

However, there is also reason to believe that there is considerable undernumeration of females especially in rural areas.

As an example, different coding practices of census data in Turkey and Syria have resulted in widely different female participation rates in agricultural areas which share a national border[16]. There is also reason to believe there is similar undernumeration in the Egyptian rural sector. Ibrahim [1985], cites an example of this. The 1960 census recorded that females constitute 4% of the agricultural labour force, whereas a more detailed labour survey put this figure at 25%. Much the same situation exists in urban areas, where studies have shown that up to 40% of adult females take part in income generating activities[17].

The rest of this section discusses the direct and indirect effects of recent governmental policies in Egypt, most of which have effected the female labour force.

First of all, the nature of female work needs to be taken into account, most importantly for any planned governmental policies. Females work as unpaid family members alongside the work they share in the labour market : resposibilities at home include child-bearing and child-rearing. Bindary et al (1973) suggested that female work could influence child-bearing and that the nature of the work determined whether this is a stimulus or disincentive. The conclusion reached is that agricultural work for females would seem to encourage large families, but industrial and commercial work tends towards small families. Agricultural employment is readily available for females in rural areas : if the family is large, wives and children support the husband's income. Industrial and commercial work requires regular hours so that conditions of work make child-rearing, when the children are young, and employment uncomplementary.

Table 2.3 The size of the labour force and crude activity rates by Sex and Urban and Rural Areas 1960, 1976

Area	Urban				Rural			
Sex	Males		Females		Males		Females	
Year	1960	1976	1960	1976	1960	1976	1960	1976
Number in labour force (000s)	2461	4219	280	630	4746	5925	345	358
Growth of labour force (000s)	1758		350		1179		12	
Annual % growth rate	3.4		5.1		1.4		.2	
Activity rate	49	51	5.8	8.1	59.0	56.9	4.3	3.5
Change in activity rate	2.3		2.3		-2.1		-.8	
Population component of change in labour force	65		73		29		24	
Activity component of change in labour force	6		51		-4		-20	
Total % change in labour force	71		124		25		4	

Source: Tables 1-3 Nassef (1980).

Table 2.4 The Economically Active Female Population

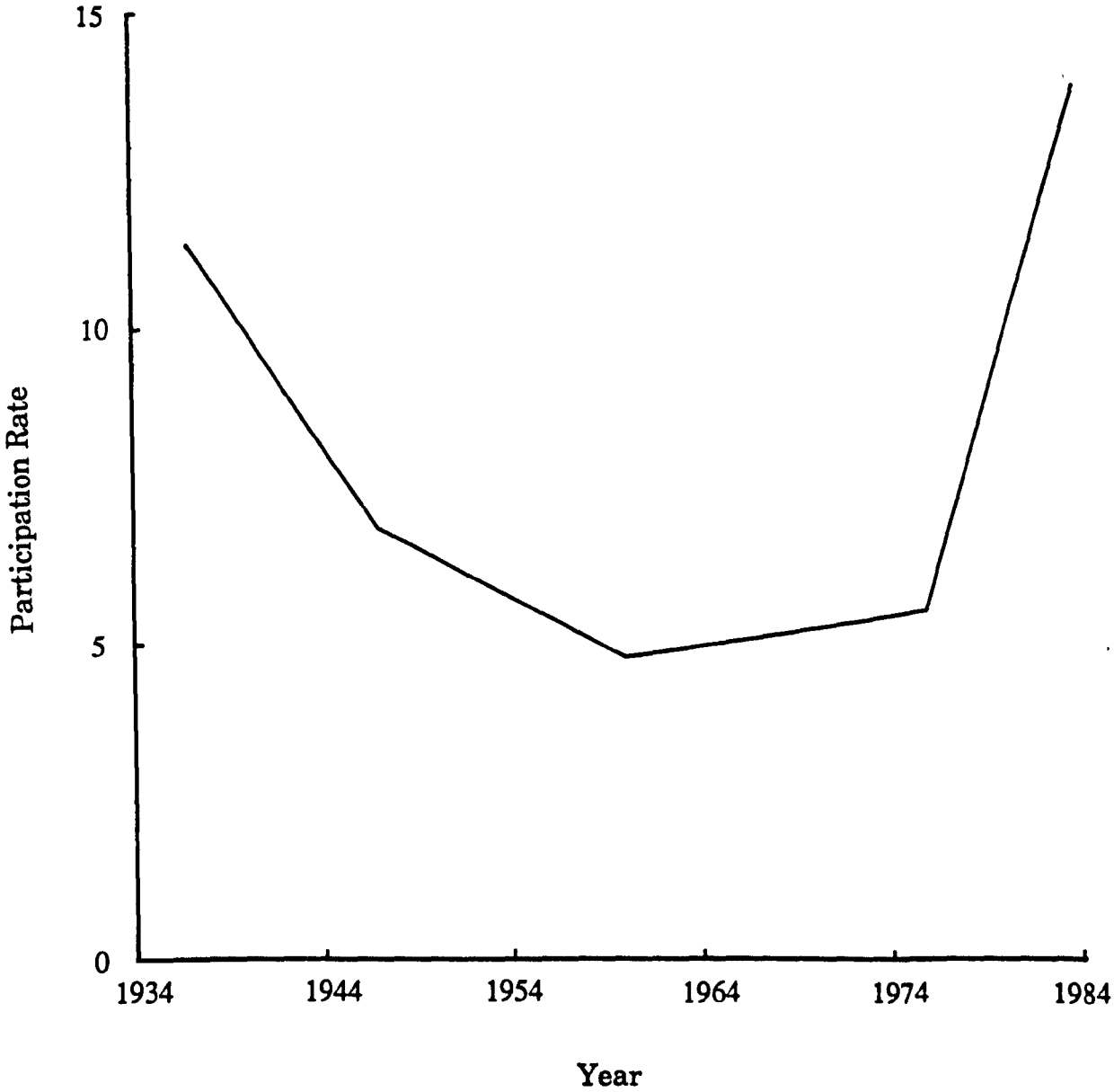
1937-1984

Year	Age Range	Population (000s)	Labour Force (000s)	Participation Rate
1937	5+	7,954	897	11.3
1947	5+	9,575	649	6.8
1960	6+	12,389	614	4.8
1976	6+	17,979	988	5.5
1977				5.3
1978				6.0
1979				5.4
1980				5.7(16.7)
1981				5.9
1982				5.8
1983				12.5
1984				13.8

Sources: Yearbook of Labour Statistics, Nagi (1971).

1937-1976 census figures.
1977-1984 LFS figures. Figure in bracket EFS rate: ever-married females 15-49.

Figure 2.2 Female Economic Participation, 1937-1984.



(1)

Table 2.5 A cross-national comparison of activity rates

Continent	Country	Activity Rate (%)(2)		
		Males	Females	Persons
Africa	Egypt	54.4	5.5	30.4
	Algiers	39.5	3.8	21.5
	Nigeria	50.4	51.5	50.4
America	Argentina	55.5	21.9	38.7
	Honduras	49.2	9.3	29.3
	US	57.4	38.5	47.7
Asia	Iran	47.8	8.9	38.9
	Israel	43.3	24.2	33.7
	Malaysia	47.4	26.0	36.8
	Syria	41.2	8.0	24.9
Europe	France	54.2	32.3	43.1
	Poland	57.4	45.4	51.2
	Spain	51.3	20.7	35.7
	UK	59.4	35.4	47.1
Australia		57.7	32.6	45.2

Source: Yearbook of Labour Statistics (1980).

(1) Rates measured in 1970-80 decade.
(2) Proportion of total population in labour force.

Table 2.6 Hours of work and wages in Egyptian non-agricultural and manufacturing sectors, 1960-1976

Year	Non-Agricultural		Manufacturing				
	Hours (Per Week)	Wages (Piaster/ Week)	Hours	Wages			Male/ Female Wage Ratio
				Male	Female	Total	
1960	49	238	-	-	-	-	-
1961	48	236	-	-	-	-	-
1962	47	229	47	219	117	212	.53
1963	45	263	44	252	154	246	.61
1964	44	279	44	271	171	264	.63
1965	53	323	53	305	235	301	.77
1966	62	343	62	336	247	334	.74
1967	49	331	49	324	229	318	.71
1968	50	336	50	363	246	356	.68
1969	49	402	49	410	298	403	.73
1970	55	401	55	406	258	397	.64
1971	56	399	55	401	269	392	.67
1972	55	450	54	468	320	458	.68
1973	56	467	55	476	308	466	.65
1974	60	531	59	534	336	524	.63
1975	58	558	59	553	375	541	.68
1976	56	652	56	663	498	651	.75

Source: Yearbook of Labour Statistics

Availability of medical contraceptive services is essential governmental policy if females are to take up urban jobs and opportunities available to them. The conclusion reached by the Egyptian fertility survey of 1980 is that contraceptives in at least the two largest cities Cairo and Alexandria, are easily available.

Despite government policy to shorten the working week,[18] table (2.6) shows no observable trends in the average weekly hours worked per worker. This is in contrast to the trend observed in developed countries, which is one of a declining length of working week. The two Arab-Israeli wars in 1967 and 1973 undoubtedly had some effect in raising the hours worked by individuals. The rise in the male/female wage ratio, however, is expected to encourage greater female market participation.

An important factor influencing the size of the female labour force is the status of females in Egypt. According to Nagi (1971), two major trends have resulted in the improvement of the status of females. The first concerns the open acknowledgement of the equality of the sexes in the 1962 national charter. The second trend, resulting from the extension of free education until university level, is towards increasing the educational attainment of females. The proportion of female/male enrolment increased from 39% in 1966/7 to 40.9% in 1981/2 for primary level (6-12 years); 30.6% to 38.5% for intermediate level (13-15 years); 30.1% to 36.7% for secondary level (16-18 years). For university level the increase was from 30.5% in 1972/3 to 33.8% in 1981/2[19].

The extension of free education until University level has also meant that youths could delay entrance into the labour market[20].

This may lead to an indirect positive effect on female labour supply due to the need to support education of youths in the family. Even so, low income families may still not be able to forego the income which could be earned by having the youths working rather than continuing their education.

Another incentive to continue education is the government policy of guaranteed employment for graduates of high education institutes (mentioned earlier). This policy should also delay entrance of youths into the labour market. Moreover, the combined effect of free education and a guaranteed employment policy should increase the supply of the educated labour(21).

The period of military draft was lengthened during the interwar period, that is between 1967 and 1973. The effect was to decrease the supply of primary workers (adult males) and increase that of secondary workers (females, young and old pople). The entrance of secondary workers into the labour market could be attributed to the need to supplement family income since conscript's income was (and is) only nominal. During this period, Egypt may have experienced an "added worker" effect, though the causes are different from those in the developed countries(22).

Another policy which may have an indirect effect on female labour supply is the facilitating of emigration to the Arab countries. This has resulted in less pressure on the demand for jobs at home, thus possibly enabling females to seek employment. This has also meant that females find themselves head of households with greater responsibilities, thus possibly motivating them to seek employment in the labour market if childcare could be the

responsibility of another relative.

2.4 Sources of Data

Modern census taking in Egypt began with the 1882 census followed by a second census in 1897, after which it was taken every ten years until 1947. The 1957 and 1967 censuses were postponed because of the Middle East conflicts so that the last three censuses were taken in 1960, 1976 and 1986 (still to be published).

Labour force statistics were collected during census years starting from 1897. However, their utility was limited because of the delay in release and because they are so far apart[23]. There are other limitations concerning census data in reporting female activity rates. As mentioned before, census questionnaires ignore unpaid work of females either in household production or in agricultural activity.

This partly led to the use of a census-type survey : the labour force sample survey. The first survey was carried out in 1942 and was taken twice per year in January and July until 1965 when data gathering took place yearly in October (the choice being so that the beginning of the calendar year and financial year (1st July) are avoided.

The objectives of the survey are to:

(1) measure the volume of the labour force;
(2) ascertain the geographical, sex, age and industrial distribution of persons in the labour force;

(3) measure the percentage unemployed.

The data is gathered at firms in which there are at least ten employees; the frame of the survey being taken from the latest census. There seems to be a defect in using this data set. As will be seen later (Chapters IV and V), about 40% of households report no household cash income (i.e., total income - female earnings). The most probable reason is error in reporting of the wages of other family members.

Other sources of data include several national surveys - among them the 1980 Egyptian fertility survey. A full description of Survey Design is given in Volume I of publications produced. The survey is a nationally representative probability sample of households. The primary sampling units are shiakhas; districts in urban areas, and villages - rural units. The core of the survey was the individual questionnaire for ever-married females (15-49). A component of this contained an account of the work history of the female. There are six data files available for use. In this study use is made of one data file (VC01) in which income data is available. The size of this is 1/3 of all the sample. Another data file (SR03) is also useful for a study of this kind, but income data is not available.

NOTES:

(1) For the sake of comparison, birth rates for other countries are (for 1980) Algeria; 43.9, Kuwait; 37.3, Israel; 24.3, England and Wales; 13.2 (Source: Demographic Yearbook 1986).

(2) Lewis (1954) and Mabro (1967) discuss whether this characterisation is applicable.

(3) Marginal productivity of labour is defined as the increase in output resulting from the addition of one more unit of labour.

(4) Textbooks on development economics such as Yotopoulos and Nugent (1976) deal with the labour-surplus hypothesis and its relevance to the present day employment problem.

(5) Ikram (1980), pps.116-7 and 212-6. Lack of employment opportunities is undoubtedly one of the major push factors in migration, education being the strong pull factor.

(6) Mabro (1967), pps.325-6.

(7) 1 feddan = 4,201 square meters.

(8) Hansen & Radwan (1982) Chapter 6 and for the interaction between the submarkets in the economy pps.143-6.

(9) See Ikram (1980), Chapter 7. Nearly 56% of those employed in the public sector are educated as compared to 6% in the private sector.

(10) Extras over the basic wage rate can amount to a maximum of 50% in the government and 100% in public enterprises (see Korayem (1984), p.70). In 1975 a general cost of living allowance was introduced and in 1978 more freedom was given to public enterprises in setting the wage of the individual market.

(11) Hansen & Radwan (1983), pps.14-15. Improvement to the system should include greater differentiation on the bias of specialisation in skills in short supply. The seniority system could also be revised in favour of an incentive system.

(12) Hansen & Radwan [1983], pps.82-92 contains information about immigration to the Arab countries.

(13) See Hansen and Radwan (1982) and Serageldin et al (1983).

(14) The labour force is defined as the total of employed and unemployed. Lower and upper age limits are usually included (6 years or 15 years as a lower limit, 65 as an upper limit). To count a person as employed, some nations stipulate a minimum number of hours worked per week (Yearbook of Labour Statistics). The structure of the employed labour force 1960; 1976 is thoroughly covered in Korayem (1984), pps.39-60.

(15) The explanation proposed by Youssef (1971) is that the low participation rates can be explained by the social structure of Middle Eastern Society. The favouring of sexual segregation has resulted, via social barriers and institutional mechanisms, in preventing women from taking part in public activities that bring them into contact with the opposite sex.

(16) Bishrat [1985], pps.22-25.

(17) Ibrahim [1985], p.13.

(18) This came into operation officially in 1961 when the working week was shortened from 48 to 42 hours in public enterprises. See Korayem (1984), pps. 3-4. This policy was put in effect in 1962. For more details see Korayem (1984), pps.4-5.

(19) These figures are taken from Seatherum (1983), tables (4.1) and (4.6).

(20) Korayem (1984), p.7.

(21) Korayem (1984), pps.9-10.

(22) See Korayem (1984) for further details.

(23) See Nagi (1971), Introduction.

CHAPTER III THE THEORETICAL FRAMEWORK

Two trends in the industrialised countries have raised interest in work behaviour; the declining number of hours worked by males and the substantial increase in labour force participation by females[1]. Robbins' paper (1930) has led to the approach of analysing the effect of wages and income on the supply of labour. This approach proposes that the individual divides the time available between work and leisure time; or using a more appropriate term for leisure : non-market uses of time.

In this Chapter the basic labour-leisure choice model is presented in sections (3.1) and (3.2). Non-market uses of time, such as child-bearing, are considered to be of importance in the case of married females. Section (3.3) presents an extension of the basic model which stresses this aspect of female behaviour.

3.1 The Basic Model

Neo-classical labour supply theory assumes that the individual's behaviour is governed by a function, called a utility function[2], consisting of two variables; consumption goods and leisure time. The individual acts so as to maximise utility, which is bounded by two constraints: a time constraint and an income constraint. Following conventional consumer analysis, a function for the demand for leisure is defined from which a supply function for work time is obtained.

3.1.1 The Utility Maximisation Problem

An individual is assumed to maximise the utility function, U:

$$U = U(C, L) \qquad (3.1)$$

Subject to:

(1) An income constraint:

$$PC = WH+I \qquad (3.2)$$

and,

(2) A time constraint:

$$H+L = T \qquad (3.3)$$

Where:

C : Market goods purchased

L : Amount of time spent in leisure or non-market activities

P : Price index

W : Wage rate

I : Assets or unearned income

H : Number of hours worked

T : Total amount of time available during the period

C and L are considered to be Hicksian composites(3).

Since H = T-L, the income and time constraints can be combined:

$$W(T-L) + I = PC \qquad (3.4a)$$

or

$$WT + I = PC + WL \qquad (3.4b)$$

The term on the right hand side of (3.4b) shows the expenditure of this income on either market goods, valued PC, or on leisure time, WL, the shadow price of which is the forgone wage of the individual(4).

The constrained maximisation problem can be solved by setting up a new function, the Lagrangian U^*, which takes into account constraint (3.4b) on the original problem.

$$\text{Max } U^* = U(C,L) + \lambda\,[W(T-L)+I-PC]$$

Where λ is known as the Lagrangian multiplier and is interpreted here as the marginal utility of income.

The first order partial derivatives with respect to C, L and λ of the Lagrangian are set equal to zero, satisfying the first order conditions:(5)

$$\left.\begin{aligned} \frac{\partial U^*}{\partial L} &= \frac{\partial U}{\partial L} - \lambda W = 0 \\ \frac{\partial U^*}{\partial C} &= \frac{\partial U}{\partial C} - \lambda P = 0 \\ \frac{\partial U^*}{\partial \lambda} &= W(T-L)+I-PC = 0 \end{aligned}\right\} \qquad (3.5)$$

3.1.2 The Labour Supply Function

The first order conditions (3.5), provide a system of three equations in six variables. For a given set of numerical values of W, I and P a unique solution for L, C and λ is obtained. Assuming P

to be an exogeneous variable, then the demand for leisure time can be represented as:

$$L = L(W, I)^{(6)} \qquad (3.6)$$

Since H=T-L, the hours function can be represented as:

$$H = T-L(W, I) = H(W, I) \qquad (3.7)$$

The simple model as represented by equation (3.7) is not one that is suitable for empirical application. As stated by Killingsworth (1983, p.19): "... the simple model focuses on the role of pecuniary variables - notably, the wage and property income - in labour supply decisions. However, this does not mean that the model implies that such factors "explain" (...) "all" (...) of an individual's labor supply or that individuals respond only to (changes in) pecuniary factors ... . Moreover, as previously noted, the simple model also implies that "tastes" - that is preferences, or more technically indifference curves - affect labour supply decisions".

Alongside wage and income variables,[7] other factors such as education and family size and composition, denoted by the array $\bar{A}$, are added to the model to control for factors relating to differences in preferences. The extended model can be represented as:

$$H = H(W, I, \bar{A}) + \epsilon \qquad (3.8)$$

Where ϵ represents a random error term introduced into the model

to take into account errors: measurement errors, errors of omitted variables both observed and unobserved (including tastes).

The form of the demand for leisure function and hence the supply of labour function depends on the form of the utility function U. In most studies, however, the specification of the labour supply function is assumed to be an emprirical problem(8); a linear approximation to the labour supply function is usually adopted:

$$H = \alpha_0 + \alpha_1 W + \alpha_2 I + \sum_{i=3}^{n} \alpha_i a_i + \epsilon \qquad (3.9a)$$

Where:

α_i : represent constant parameters

ϵ : normally distributed random error term

n : number of explanatory variables

Let:

$\bar{B}$: be an array denoting all the explanatory variables

$\bar{\alpha}$: be an array denoting all the α_is

$\bar{\alpha}^T$: be the transpose of $\bar{\alpha}$

(3.9a) is more simply stated as:

$$H = \bar{\alpha}^T \bar{B} + \epsilon \qquad (3.9b)$$

The parameters $\bar{\alpha}$ are then estimated using least squares for the whole population, i.e., working and non-working females. When a sub-group of working females is taken as a sample, least squares provides biased and inconsistent estimates. This is because a sub-group chosen on the basis of the individual's work status (an endogeneous variable since participation and hours are considered to be jointly determined) is not a random sample. For the hours function of workers, hours observed, H, have to be greater than zero for inclusion of the individual, i.e., H >0. This problem is

presented statistically in section 3.2.

The simple model represented by the function in (3.8) is adequate if the utility maximisation problem has an internal solution. In the case of the individual this means that H $\neq$0. For some sub-groups of the population; females, young and old people of both sexes - this is not the case. In the next section, the labour force participation decision is examined.

3.2 The Labour Force Participation Decision

Labour force participation is another dimension of labour supply. Ben- Porath [1973b] pointed out the need to examine the nature of the participation decision in order to estimate a valid participation function. There are two interpetations that can be given to the observed participation rate.

Initially, many studies used a participation function where participation and hours are interchangeable measures of labour supply, i.e.:

$$P = P\ (W,\ I,\ \overline{A}) + \epsilon \qquad (3.10)$$

Where P denotes the labour force participation rate for a group or a dummy variable representing the labour force status of the individual.

This model, which was proposed by Mincer (and used by others)[9] has an implicit underlying assumption of life-cycle labour force behaviour. Mincer (1962) presents a one period model of female

labour force behaviour in which the period is a life-time. The timing decision of work activity is given by a profit maximising principle: a female works when it is financially profitable relative to non-market activity(10).

This approach implies that the labour force participation rate for a group of females represents an estimate of the average fraction of time that every female in that group wishes to spend in the labour force. Individual differences lie in the timing of labour force entry. This depends on variation in costs and opportunities due to random "transitory" factors such as presence of children or unemployment of the spouse.

According to Ben-Porath (1973b), this is not the only interpretation that can be given to the participation rate and might be one that is not true to the real situation(11). The alternative view given is that the participation rate reflects individual differences in tastes among females that can be attributed to differences in the utility function. So, the labour force participation rate represents the proportion of females who want to participate in the labour market.

Using U.S. census data, he concluded that current non-participation was a good indicator of permanent non-participation(12). It seemed there was enough weight to the second viewpoint for further investigation. This prompted the development of a different empirical approach to the one outlined in the next paragraph.

In the same way as for the hours equation, empirical

specification leads to the use of a linear probability of participation function:

$$P = \alpha_o + \alpha_1 W + \alpha_2 I + \sum_{i=3}^{n} \alpha_i a_i + \epsilon \qquad (3.11a)$$

or more simply:

$$P = \bar{\alpha}^T \bar{B} + \epsilon \qquad (3.11b)$$

where:

$0 < p < 1$

$\bar{\alpha}$: array denoting constant parameters

$\bar{B}$: array denoting set of explanatory variables

ϵ : normally distributed random error term

n : number of explanatory variables

For this model, estimation using least squares on the unrestricted or untransformed dependent variable can lead to prediction of p that lies outside the zero-one range. A probit transformation of p transforms the dependent variable from a finite to an infinite range, thus overcoming this problem(13).

Gronau (1973a) and Heckman (1974a) developed the second approach proposed by Ben-Porath. The conceptual approach is also based on the utility maximisation principle: the marginal value of a commodity equals its market price if some quantity of the commodity is purchased and the marginal value at zero quantities of a commodity is less than its market price if no amount is purchased. In terms of the participation problem, the probability of

participation is seen as depending on whether market wages exceed the shadow price (subjective evaluation) of time[14].

A two equation model is developed. Labour supply behaviour is determined by:

$$W = W(\bar{X}, \epsilon_W) \qquad (3.13)$$

$$W^* = W(\bar{Y}, \epsilon^*) \qquad (3.14)$$

where:

W : potential market wage

W^* : shadow price of time (own wage)

$\bar{X}$: array denoting a set of variables determining market wage (number = n)

$\bar{Y}$: array denoting a set of variables determining own wage (number = m)

ϵ_W, ϵ^* : normally distributed random error terms that embody specification errors

The participation model is thus given by the inequality:

$$\left.\begin{array}{l} W < W^*(0) \\ W > W^*(0) \end{array}\right\} \begin{array}{l} \text{if female does not work} \\ \text{if female works} \end{array} \qquad (3.15)$$

Where $W^*(0)$ is the own wage function when the female is working zero hours.

For clearer exposition, let the functional form of W and W^* be linear[15]:

$$\left.\begin{aligned} W &= \bar{\alpha}^{T}\,\bar{X} + \epsilon_{W} \\ W^{*} &= \bar{\beta}^{T}\,\bar{Y} + \epsilon^{*} \end{aligned}\right\} \qquad (3.16)$$

Where $\bar{\alpha}$, $\bar{\beta}$ are arrays of constant parameters.

The procedure is then to estimate the structural parameters $\bar{\alpha}$, $\bar{\beta}$.

The first problem is identification of the system. The variables in $\bar{X}$ and $\bar{Y}$ are possibly overlapping endogeneous and exogeneous variables. The exclusion of one variable in $\bar{Y}$ that is present in $\bar{X}$ will at least ensure identification of the equations.

The market wage is mainly determined by education and work experience, and, these variables also influence the own wage of a female. However, there is no theoretical guidance in choosing the identifying restriction. Assuming experience is the identifying variable, this variable is removed from the set of determining factors $\bar{Y}$.

However, there is still the problem that the shadow price of time is an unobservable variable, resulting in the need for indirect estimation of $\bar{\beta}$.

Restating the participation condition:

$W > W^{*}(0)$ if a female works

Where $W^{*}(0)$ is W^{*} defined at zero hours worked (h=0).

Inequality (3.15) implies that the condition for work is:

$$W - W^*(0) > 0 \qquad (3.17)$$

By substituting equations (3.16) into inequality (3.17):

$$[(\bar{\alpha}^T \bar{X} + \epsilon_w) - (\bar{\beta}^T \bar{Y} + \epsilon^*)] > 0 \qquad (3.18)$$

or $$(\bar{\alpha}^T \bar{X} - \bar{\beta}^T \bar{Y}) > (\epsilon^* - \epsilon_w) \qquad (3.19)$$

Letting $\bar{y}^T \bar{Z}$ represent $(\bar{\alpha}^T \bar{x} - \bar{\beta}^T \bar{Y})$ (16), an expression for the probability of working is given by:

$$P = Pr\ (\bar{y}^T \bar{Z} > \epsilon) \qquad (3.20)$$

The specification of the distribution of ϵ allows the use of maximum likelihood methods of estimation(17). It is convenient to assume that ϵ has a mean of zero and is normally distributed in the population as a whole. Then the transformed variable ϵ/σ has a mean-zero, following a standard normal distribution; σ is the standard deviation of ϵ.

The probability that a given female with a predetermined set of characteristics, represented by $\bar{Z}$ works:

$$P(p=1) = Pr\ (\bar{y}^T \bar{Z} > \epsilon) =$$

$$\frac{1}{2\pi} \int_{-\infty}^{(\bar{y}^T \bar{Z}/\sigma)} e^{-t^2/2} dt = F\ (\bar{y}^T \bar{Z}/\sigma) \qquad (3.21)$$

The probability that a given female does not work:

$$P(p=0) = Pr\ (\bar{\alpha}^{T}\bar{Z} < \epsilon) =$$

$$\frac{1}{2\pi}\int_{(\bar{y}^{T}\bar{Z}/\sigma)}^{\infty} e^{-t^2/2}dt = 1-F\ (\bar{y}^{T}\bar{Z}/\sigma) \qquad (3.22)$$

Where a value of p=1 is assigned to every female that works and a value p=0 to every female that does not work.

Setting up the likelihood function for a poulation of k females, where the first j are workers gives:

$$L = \prod_{i=1}^{j} F\ (\bar{y}^{T}\bar{Z}/\sigma) \prod_{i=j+1}^{k} [1-F\ (\bar{y}^{T}\bar{Z}/\sigma)] \qquad (3.23)$$

Probit maximum likelihood procedure is then used to estimate (σ) normalised $\bar{\gamma}$ coefficients, since the estimation procedure uses the standardised cumulative normal transformation.

The coefficients of the market wage function are then estimated using least squares. However, in the case of using a sample of workers, selection bias arises(18) and, if education increases participation, then a higher proportion of those educated will be found in the sample of workers underestimating the effect of education on wages(19). This is also the case for the hours function of workers.

Heckman (1980) treats selection bias as a specification error (missing variable) problem and proposes an estimator that enables OLS estimation procedure free of selection bias.

One can write the population wage function as:

$$W = \bar{\alpha}^{T} \bar{X} + \epsilon_{W} \qquad (3.24a)$$

and:

$$E(W|\bar{X}) = \bar{\alpha}^{T} \bar{X} \qquad (3.24b)$$

However, it would be reasonable to assume that the error term (tastes for work) ϵ_{W} is higher among a sub-group of workers, so that:

$$E(W|\bar{X}, H > 0) = \bar{\alpha}^{T} \bar{X} + E(\epsilon_{W}|\epsilon > -\bar{\gamma}^{T} \bar{Z}/\sigma) \qquad (3.25)$$

Stating that ϵ and ϵ_{W} are correlated means that:

$$E(\epsilon_{W}|\epsilon > -\bar{\gamma}^{T} \bar{Z}/\sigma) \neq 0 \qquad (3.26)$$

Heckman's estimation procedure provides a value to expression (3.26):

$$E(W|\bar{X}, H > 0) = \bar{\alpha} \quad \bar{X} + (\sigma_{\epsilon W, \epsilon}/\sigma)\,\lambda + \epsilon_{\lambda} \qquad (3.27)$$

Where:

$$\epsilon_{\lambda} \simeq N(0,1)$$

and:

$$\lambda = f(-\bar{\gamma}^{T}\bar{Z}/\sigma)/\,[1-F(-\bar{\gamma}^{T}\bar{Z}/\sigma)]$$

Where f and F are the density and cumulative distribution function of the standard normal random variable. Heckman then suggests that λ can be estimated from the probit on the participation function, and calculates the correction for selectivity bias in the hours function of workers as:

$$E(H|\bar{V}, H > 0) = \bar{\theta}^{T}\bar{V} + \sigma\,\lambda + \epsilon_{\lambda} \qquad (3.28)$$

Where $\bar{V}$: array denoting a set of variables determining hours worked

$\bar{\theta}$: array of parameters

From (3.28), one can obtain a value for σ and calculate values for $\bar{\alpha}$.

From the coefficients of $\bar{\alpha}$ and $\bar{\gamma}/\sigma$ in equations (3.23) and (3.24a), σ can be calculated. Then from the relation $\bar{\gamma} = (\bar{\alpha} - \bar{\beta})$, $\bar{\beta}$ can be determined.

Other empirical procedures include that of Heckman [1974]. This procedure allows for joint estimation of the probability of participation and hours of work. If a female works, her hours of work adjust to equate market wage and own wage (if she has the freedom to set market wages)(20). However, this procedure was not used widely because of computational expense. The method outlined previously (or a variation of it) is the one most commonly used and the procedure applied in the present study.

In the next section aspects specifically related to female labour supply are examined.

3.3 Female Labour Supply

The decision to work by females is one of many decisions that have to be taken within the household. Variables such as age at marriage, cumulative fertility, educational attainment and labour force participation are conditioned by economic factors. These types of behaviour also strongly interact and have roots in a common set of attributes of the individual. Analysis should thus seek to specify and estimate these relationships simultaneously. A number of studies have attempted to place the participation decision into a broader framework(21). These will be discussed in this section.

The relationship between the decision to work and the decision to bear children is considered to be important especially in less developed countries where high birth rates might place a burden on the national economy. The determination of family size is brought within the utility maximisation framework. Fertility phenomena are explained in terms of the price of children and real income; the chanel through which fertility bears on labour force participation (or vice-versa) is through the price of children - one part (possibly a major part) being the value of the mother's time.

3.3.1 Time Allocation Model

Malthus' theory of population change marks the beginning of the association between pooulation change and economic indicators. Malthus' hypothesis is that an increase in income should lead to

larger family size for two reasons:

(1) An increase in income would reduce child mortality enabling more children to survive to adulthood. Therefore, if the decrease in births did not outweigh the decrease in child mortality, family size would increase.

(2) Increasing income would give greater motivation towards earlier marriage and less abstention during marriage.

The development and spread of contraceptive knowledge increased the scope of family decision-making inducing Becker (1960) to analyse the determination of family size within an economic framework offering a generalisation and extension to Malthus' theory(22).

Children are assumed to be a source of satisfaction; in economic terms they are considered a consumption good (if they provide money income they are assumed to be a production good as well). Children provide utility via a utility function. There are costs attached to children and presumably a family determines the expenditure on each child - the term given to this being "quality" of child. Expenditure on children would take the form of better health care and nutrition, investment in education and formation of attitudes (which requires time).

Becker's hypothesis is that the demand for children has to relate to quantity of children and quality of children. The

dramatic decline of fertility in developed countries over the past century could be interpreted as being the result of a greater responsiveness of quality of children to quantity of children with increasing income(23).

Becker (1965) developed an approach to labour supply behaviour that incorporates the non-working time of an individual. The assumption of the time allocation model is that households combine time and market goods to produce commodities that enter into the utility function (as in equation (3.1)).

The following sets out a version of Becker's utility maximisation problem.

Let:

Z_i : commodity i produced

$\bar{x}_i$: vector of market goods required to produce commodity i

t_i : time input required to produce commodity i ($\bar{t}_i$ is used if one assumes that time in different periods (weekdays, weekends) can be distinguished)

F_i : Household production function for commodity i

Z : Limit on resources

The individual produces Z_i via a household production function:

$$Z_i = F_i (\bar{x}_i, t_i) \qquad (3.29)$$

Maximising the utility function, U :

$$U = U(\bar{Z}) \equiv U(\bar{F}) \equiv U(\bar{x}, t) \qquad (3.30)$$

Subject to the constraint

$$\Sigma Z_i = Z \qquad (3.31)$$

Utility is, as in the basic model, a function of market goods and time. Thus the conclusions (derivation of the labour supply function) are the same. However, as pointed out by Killingsworth (1983, p. 42-3), the importance and most interesting application of this approach is its analysis of aspects of non-market uses of time. It defines the problem in a clear fashion, but essentially reaching the same conclusions as the basic model.

The following sets out a model based on those developed by Willis (1973) Ben-Porath (1973a) that extends the Becker model. Children are treated as one of the commodities produced by the household.

Let :

Ch : services from children
N : number of children
q : constant
C : consumption level

Then:

$$Z_1 = {}_qN = F_N(\bar{x}_N, t_N)$$

$$Z_2 = C = F_C(\bar{x}_C, t_C) \qquad (3.32)$$

Where:

Z_1 : production of children

Z_2 : production of consumer goods

$\bar{x}_N$: market goods required for children

t_N : time required in child services

$\bar{x}_c$: market goods required to produce commodity c

t_c : time required to produce commodity c

The individual maximises the utility function:

$$U = U(Ch, C) = U(qN, C) \tag{3.33}$$

Assuming that the number of children is a measure of child services (3.33) becomes; U(N, C); subject to the production functions for children and commodities:

$$\left.\begin{aligned} N &= f^N (t_N, \bar{x}_N) \\ C &= f^c (t_c, \bar{x}_c) \end{aligned}\right\} \tag{3.34}$$

and resources constraints :

$$\left.\begin{aligned} t_N + t_c + t_L &= T \\ I + t_L w &= P (\bar{x}_N + \bar{x}_c) \end{aligned}\right\} \tag{3.35}$$

These constraints can be combined to form one constraint:

$$I + (T - t_N - t_c)\, W = P(\bar{x}_N + \bar{x}_c) \tag{3.36}$$

Where:

t_N : time input in child services

t_c : time input in commodity services

t_L : time allocated to the labour market

T : total time constraint

I : non-labour income

P : price index of market goods

Willis (1973) considers whether the production functions are the relevant constraints on utility maximisation. In reality, household production and household consumption are determined simultaneously. Maximisation of utility is thus subject to the income constraint (3.36) and as previously described, demand functions are derived from optimising the Lagrangian:(24)

$$\text{Max } U^* = U(N, C) + \lambda [(T-t_N-t_C) W+I-P (\bar{x}_N + \bar{x}_C)] \qquad (3.37)$$

Two functions are of interest in this study: the demand for children (family size determination) and the wife's labour force participation. The constraint faced by the family for the demand for children depends on the wife's labour force participation decision. Thus, the hypothesis proposed by Willis's model implies the following:

$$\begin{aligned} N &= N_1(\bar{A}) + \epsilon_1 \quad \text{if } L = 0 \\ &\quad\ N_2(\bar{B}) + \epsilon_2 \quad \text{if } L = 1 \\ L &= L(\bar{C}) + \epsilon_3 \end{aligned} \qquad (3.38)$$

Where:

L : labour force participation

$\bar{A}$, $\bar{B}$: arrays denoting a set of variables determining the demand for children

$\bar{C}$: array denoting a set of variables determining labour force participation

$\epsilon_1, \epsilon_2, \epsilon_3$: random error terms

The choice of variables in arrays $\bar{A}$, $\bar{B}$ and $\bar{C}$ has been determined according to assumptions regarding the nature of the joint-determination of these functions. This point is discussed in section (5.5.2).

In the final section of this Chapter, the main determinants of female labour supply are discussed.

3.3.2 Determinants of Female Labour Supply

The main demographic factors influencing the size and composition of the supply of female labour are: (1) marital status; (2) size and age composition of the household and; (3) age of the female.

Traditionally, division of labour in households has meant that married females have specialised in child-bearing and other domestic activities, while married males have engaged in "market" activities (hunting, farming, etc.) that provide a source of income; and leaving the married female with the risk of abandonment. Thus, nearly all societies have developed long-term protection for the female, in the form of a marriage contract(25).

This means that, depending on the extent to which the husband's role is viewed as that of provider, one of the expectations of marriage of the female is that of partial or total financial

support[26]. Thus market participation of married females is expected to be lower because of; (1) the availability of another source of income (husband's) and; (2) the increased responsibility of domestic work which provides a substitute to market work.

Empirical studies treat marital status as a control variable. Females are classified according to presence of husband in the household:

(1) Married females (husband present)
(2) Single females, i.e., all other females. These include:
    (a) Married females, husband absent
    (b) Never-married females
    (c) Divorced females
    (d) Widowed females

The participation rate for single females is higher than that for married females because:

(1) Absence of the husband due to separation divorce or death is expected (due to marital instability or due to differing location for work) to increase participation due to increased financial responsibility. This will depend on perceived marital instability and other sources of income[27].

(2) Career interests may be the reason why some females might serve to increase their tastes for work. Again, financial pressure would also induce a higher participation rate[28].

One of the purposes of marriage is procreation. Females have a biological committment to the production and feeding of children. Females also are willing to spend much time and energy in caring for their children; they want their biological investment in production to be worthwhile.

In addition to this, a mother is able to care for older children while she "produces" additional children rather than while she engages in other activities. That is, there is complementarity between bearing and rearing children. Such specialised investment in the household sector reinforces any biologically induced sexual division of labour.

The complementarity of child-bearing and work has been studied by Bindary et al (1973) and McCabe and Rozenzweig (1976). In less developed countries a large portion of the labour force is employed in cottage industries and retailing occupations in which on-the-job child care is possible(29). The measure of a similar type of variable has been described by Bowen & Finegan (1969) as a feminity index; the relative availability of jobs commonly held by females.

Thus for mothers, market participation is lowered because of:

(1) The comparitive advantage females have over males in the household sector due to greater investment in household activity (or conversely the comparitive advantage of males over females in the market sector due to greater market investment - therefore higher wages).

(2) The result of (1) is loss of market experience and market

productivity.

(3) Complementarity of child-bearing with child-rearing and domestic activity.

(4) The increased amount of domestic work.

The presence of children would tend to increase the mother's market participation because:

(1) There is an increase in the need for money income.
(2) Older children can provide assistance in domestic work.

The quantitative impact of children on their mother's market participation would depend on their age and number. It is expected, though, that the presence of children, especially pre-school age children, would lower the participation rate as well as have the greatest effect on the mother's market participation(30).

Life-time age-participation patterns of females are not easily predicted. Married females tend to interrupt their working lives during their child-bearing years. It seems that the process of family building starts early in adult life, when there would be an expected decline in participation(31). However, there are other reasons for a higher participation rate at young ages. The waning of vitality with life progression suggests that work should be done at younger rather than older ages. Life-cycle theory would also suggest that if the interest rate is greater than the rate of time preference then individuals will work earlier in life (see Appendix I, A3.2). Typical life-cycle patterns for married females are an

inverted U-shape when a plateau is reached in the early twenties and then a decline in rate occurs before retirement age (Bowen & Finegan, 1969). Another observed pattern is a double-peaked profile with the dips in the curve during peak child-bearing and just before retirement (see Chapter V).

The three main economic determinants of labour supply are: (1) the wage rate; (2) income and (3) unemployment of spouse (other family member).

The effect of a change in the wage rate or income is discussed in terms of income and substitution effects. An increase in the wate rate exerts two opposing effects on the hours worked by an individual. A rise in wages increases the individual's income, allowing her to consume more goods, including leisure time[32], thus reducing the amount of market work (the income effect). The increase in the wage rate also raises the price of leisure time since its price is taken as the individual's forgone earnings, i.e., the wage rate. This leads to an increase in the market work of the individual (the substitution or uncompensated wage effect).

The decomposition of the supply of hours with respect to the wage rate is given by:[33]

$$\frac{\partial H}{\partial W} = S + H \frac{\partial H}{\partial I} \qquad (3.39)$$

Where:

$\frac{\partial H}{\partial W}$: total wage effect (wage effect taking the change of income into account)

$H\frac{\partial H}{\partial I}$: income effect

S : substitution effect

$\frac{\partial H}{\partial W}$ and $\frac{\partial H}{\partial I}$ are observable quantities H cannot be ovserved, but is taken as the average hours worked in the sample under study (H_{Av}). From equation (3.39), S can be calculated.

$$S = \frac{\partial H}{\partial W} - H_{Av} \frac{\partial H}{\partial I} \qquad (3.40)$$

Theoretically the substitution effect is positive ($S > 0$) and the income derivative is negative ($\partial H/\partial I < 0$). Thus, the sign of the total wage effect in equation (3.39) cannot be predicted theoretically, but is determined empirically. The empirical evidence is summarised by Killingsworth[34]. Summing up, the evidence points towards a slightly stronger income effect for males, and a dominant substitution effect for females. This implies that male labour supply schedules[35] are gently backward bending whereas female labour supply scheduels are strongly forward sloping (in developed countries).

So far the discussion has concerned utility maximisation for an individual without regard to the effect of other family members. Two alternatives as to how earnings of other family members are incorporated into the model are[36]:

(1) In a two member family model (husband and wife), the wife treats her husband's earnings as a type of income[37].

(2) The utility maximisation problem is redefined in terms of a family utility function with a family income constraint[38]. This type of model implies that there are two types of substitution effect relevant to the labour supply of a family member:

(a) Own-substitution effect (discussed above and represented by S).

(b) Cross-substitution effect, which is defined as:

$$S_{ij} = \frac{\partial H}{\partial W_j} - H_{jav} \frac{\partial H_i}{\partial I} \qquad i \neq j \qquad (3.41)$$

where i, j represent the different family members. Assuming that the cross-substitution effects are zero, then the effect of a change in a family member's wage rate on another member's labour supply is only an income effect. The result reached here is the same as the hypothesis stated in (1), except that the husband's labour supply is also affected by his wife's change in wages.

Unemployment affects female participation in two ways:

(1) In times of higher unemployment job opportunities are less available and there would be lower expected earnings. These factors would discourage the female to enter the labour force - the discouraged worker effect.

(2) On the other hand, unemployment might affect the earnings of the husband (if he himself is not unemployed). A need to supplement family income acts as a spur for the female to enter the labour force - the added worker effect.

The existence of either of these factors is a matter of empirical determination.

Finally, a factor that is considered to have an important effect on female participation is schooling[39]. The relation between schooling and female participation is expected to be positive because:

(1) Schooling increases a female's market earnings, increasing the opportunity cost of time, thus encouraging her to substitute time at home for time in market work;

(2) Schooling gives access to cleaner more interesting jobs;

(3) Years spent at school might also be a measure of the female's natural inclination towards work. Also schooling might itself increase the inclination or taste for work, especially in relation to domestic work.

NOTES

(1) See Lewis (1957) and Long (1958).

(2) A utility function is defined as any monotonically increasing function of C and L. The Appendix (A3.1) contains a graphical presentation of the problem.

(3) This means that if prices of the bundle of goods C and the shadow prices of the different uses of non-market time, L, change in the same proportion, then C and L behave as if they were single entities Hicks (1968), pps. 312-313).

(4) The shadow price of time is defined as the price which is imputed as the true marginal value of time and which may differ from the wage rate.

(5) Second order conditions require the second order differential d^2U^* to be negative. A mathematical derivation of this condition can be found in Green (1971), pps. 306-8. The derivation is not needed for the present argument.

(6) Similarly demand functions for C and λ could be set up.

(7) Since much of the literature is concerned with the effect of wages and income on labour supply, this is presented in Appendix (A.3.2).

(8) The process of econometric specification is discussed in Killingsworth (1983), pps. 68-78. A labour supply function can be specified in three ways.

(a) Adoption of an explicit utility function, then solving the first order conditions to obtain a demand function for leisure.

(b) Derivation of a labour supply function from a functional relation obtained from the utility function.

(c) Specifying the supply function, a priori. This is the method used in this research.

(9) The studies include Cain (1966) and Bowen and Finegan (1969).

(10) In Heckman (1978) and Heckman and MaCurdy (1980) this analysis is given for Mincer's model and an explicit lifetime model is developed that explains timing of participation in terms of differences in interest rates, wage rates and the rate of time preference.

(11) See Ben-Porath (1973b) and Smith (1980) pps. 5-6.

(12) The hypothesis used is that the correlation between any two periods is strongly positive.

(13) The probit transformation is defined as the inverse of the cumulative standard normal distribution function. This linearises the original curve (which might be sigmoid in shape) so that ordinary regression procedures may be used to estimate the parameters.

(14) A graphical representation of the participation decision is presented in Appendix (A.3.1).

(15) Market wages usually have a semi-logarithmic specification because of the non-linear effect of the explanatory variables on wages.

(16) Layard et al (1980) describe $\bar{\alpha}^{T}\bar{Z}$ ($\hat{H}$ in their terminology) as a set of characteristics predisposing the individual towards market work.

(17) Use of maximum likelihood methods of estimation are preferable to OLS for a reason stated earlier, in that they ensure predicted probabilities lie in the zero-one range. Also OLS estimates are less efficient than ML estimates because of heteroscedasticity and the standard errors are not consistent so the t-test is not reliable.

(18) Selection bias arises for two reasons:

(a) Self-selection by individuals as in this case.
(b) Consequence of action taken by the analyst: this is the case when time series analysis on the labour supply of married females requires stability of the family unit.

(19) See Smith (1980).

(20) Heckman's model relies on the market and own wage:

$$W = \bar{\alpha}\bar{x} + \epsilon_W$$

$$W^* = b_1 h + \bar{\beta}\bar{y} + \epsilon^*$$

where h = number of hours worked.

For working females market and own wage are equated so that one can solve for the hours equation:

$$h = \frac{(\bar{\gamma}\bar{Z} - \epsilon)}{b_1} \quad \text{if} \quad \bar{\gamma}\bar{Z} > \epsilon^* - \epsilon_W$$

$$h = o \quad \text{if} \quad \bar{\gamma}\bar{Z} < \epsilon^* \epsilon_W$$

(21) Nerlove and Schultz (1970), Denton and Spencer (1973), McCabe and Rosenzweig (1976).

(22) Becker (1981) adds elements of Darwinian theory in his general formulation of the demand for children.

(23) Studies that deal with this issue include Becker (1960, 1981) and Willis (1973).

(24) The problem is set out fully in Willis (1973).

(25) See Becker Chapter 2 (1981) for a fuller account of the role of females in the household.

(26) It is an Islamic duty for the husband to financially support his wife and children.

(27) Islamic duty places financial responsibility of single females on their nearest male kin.

(28) One of the few studies carried out on single females is that in Bowen & Finegan (1969), Chapter 8.

(29) In less developed countries, also, some or a great deal of child care may be accepted by relatives or other family members.

(30) This is also confirmed by many empirical studies.

(31) See Layard, Barton & Zabalza (1980).

(32) Leisure is taken to be a normal commodity - an assumption that is reasonable.

(33) Mathematical derivation of this equation is found in Green (1971), pps. 310-11. However, in the labour supply problem, the sign of the income derivative is negative.

(34) Killingsworth (1983), Tables 3.2-3.5 and Table 4.3.

(35) This is a function of hours and earnings.

(36) Killingsworth (1983), pps. 29-38.

(37) The Husband does not view the wife's income in this way.

(38) An example of this type of study is Ashenfelter and Heckman (1974). For a two member family the hours supply functions would be:

$$H_m = H(W_m, W_f, \bar{X}_m, I) + \epsilon_m$$

$$H_f = H(W_m, W_f, \bar{X}_f, I) + \epsilon_f$$

where the subscripts m and f denote male and female respectively.

(39) Education differs from schooling in that knowledge can be obtained in places other than at school. Moreover school is not necessarily the most important training ground in obtaining the necessary skills of for shaping market productivities. Mincer (1974) develops a model relating schooling and experience to earnings.

CHAPTER IV: AGGREGATE STUDY

The purpose of this chapter is to study the differences in the work behaviour of females between the governerates of Egypt. An inter-governerate analysis is carried out using aggregated cross-section data from two sources; the 1984 LFS and published data from the 1976 census.

4.1 Introduction

An important characteristic of the Egyptian population (mentioned in Chapter II) is that it is concentrated in about 5% of the total area of Egypt, mostly along the Nile Valley and the Delta. There are three main area characterisations:

(1) by governerate;
(2) by urban/rural area and;
(3) by region: Lower Egypt, Upper Egypt and the Border regions.

The region south of Cairo is know as Upper Egypt, while that north of Cairo is known as Lower Egypt. Egypt is divided into twenty five governerates (1976 census), which form the political divisions of the country. There are four governerates (situated in Lower Egypt) which are considered wholly urban: Cairo, Alexandria, Port Said and Suez. The other nine governerates in Lower Egypt are comprised of both urban and rural components. Upper Egypt is divided into eight governerates, all with urban and rural components. The remaining four govenerates, which are sparingly populated comprise the Border regions.

Table (4.1) shows the geographical distribution of the population in 1976. Nearly 65% of the population live in Lower Egypt (including the urban governerates), while less than one percent inhabit the border regions. Furthermore, nearly 44% of the population (16.1 millions) live in urban areas, making Egypt a highly urbanised country for its present state of economic development(1).

The geographical distribution is affected by the regional rate of natural increase or by migration (internal or external). According to Ikram [1980 :p.143] urban growth can be attributed to migration within Egypt rather than regional differences in fertility rates. Furthermore, the pattern of urbanisation has been dominated by the country's capital city, Cairo. The trend has been towards regional redistribution of the population from Upper to Lower Egypt, particularly from rural to urban areas throughout the country, and especially to the major cities(2).

Table (4.1) shows that 44% of males and 76% of females in the labour force are situated in urban areas. This indicates a marked differential between the geographical distribution of the population and labour force between urban and rural areas for females. A higher proportion of females in the labour force compared to the total population is also found in the urban governerates and Lower Egypt. Table (4.2) shows that the urban participation rate is nearly four times that of the rural rate. Corresponding figures from the 1984 LFS indicate a higher urban rate, but a much lower differential.(3)

The lower rural rates may be attributed to the effect of urbanisation on female participation rates and possibly the underenumeration of females in rural areas. This is confirmed by participation rates from the 1980 EFS. A higher participation rate is also found in the urban governerates and Lower Egypt.

Finally, tables (4.2) and (4.3) show differentials for the participation rates of the different marital groups; they indicate the highest rate for the group of never-married females and the lowest for married females with husband present. Regional and area differences in participation rates are least for married females and greatest for divorced and never married females (LFS). The regional differential in the EFS data is greater for all the marital status groups. Area differentials are also noticable for all groups, except for divorced females, being greater in all cases, for rural areas.

Table 4.1 The Geographical distribution of the population and labour force in Egypt, 1976

Region/ Area	Numbers (000s)			% of Population to total Population		
	Population	Labour Force Males	Females	Population	Labour Force Males	Females
Lower Egypt	23,690.5	5579	648	64.7	65	77.5 (72.6)
Upper Egypt	12,672.8	3097	152	34.6	35	22 (26.8)
Border Regions	262.9	64	2	.7	.7	.5 (.6)
Urban Area	16,036.4	3992	535	43.8	44	76 (65)
Rural Area	20,589.8	5018	166	56.2	56	24 (35)
All Areas	36,626.2	9010	701	100	100	100 (100)

Source: 1976 Census

Figures in brackets are the geographical distribution of the labour force for LFS data.

Table 4.2 Participation rate of Females (25-59), by marital status, 1984

Marital Status / Region/ Area	Never-Married	Married husband present	Married head of household	Divorced	Widowed	Single	All Females
Urban Areas	54.5 (770)	13.3 (1787)	23.3 (166)	30.5 (93)	14.3 (287)	28.5 (1545)	17.6 (3332)
Rural Areas	30.1 (85)	15.3 (1142)	23.6 (109)	18.9 (30)	21.8 (296)	21.3 (724)	17.1 (1866)
Lower Egypt	52.9 (693)	14.1 (1959)	23.0 (165)	28.3 (86)	18.3 (407)	28.3 (1690)	18.3 (3649)
Upper Egypt	42.0 (153)	14.2 (962)	23.8 (110)	22.6 (155)	15.7 (174)	20.4 (565)	16.0 (1527)
All Areas	50.4 (855)	14.0 (2929)	23.3 (275)	26.5 (123)	17.3 (583)	25.7 (226)	17.4 (5198)

Figures in brackets are sizes of sub-groups.

Table 4.3 Participation rate by Females (15-49) by marital status, 1980

Marital Status / Region/ Area	Married	Separated	Divorced	Widowed	All Females
Urban Areas	14.3 (1044)	17.2 (47)	28.6 (26)	17.7 (14)	14.8 (1131)
Rural Areas	16.9 (1509)	20.6 (105)	27.6 (50)	29.3 (19)	18.2 (1683)
Lower Egypt	17.1	25.0	32.7	26.5	18.3
Upper Egypt	12.9	13.1	20.6	22.4	13.7
All Areas	15.7 (2553)	15.4 (152)	28.0 (76)	25.0 (33)	16.7 (2814)

Figures in brackets are sizes of sub-groups.

4.2 Definition of Variables and Estimation Procedure

4.2.1 Definition of variables

The set of explanatory variables used to explain the labour force behaviour of married females are: (1) average weekly earnings; (2) average weekly earnings other than female earnings; (3) unemployment rate; (4) child per woman ratio; (5) proportion of females with educational attainment higher than primary level; (6) For single females a family size variable was also used.

(1) Wage (W)

Average weekly earnings of females are taken as a measure for the wage variable. The data included daily earnings as well as monthly earnings, but these were transformed into a weekly rate. The weekly rate was chosen for the sake of expendiency; hours worked are reported weekly. Average weekly earnings is an index of the wage a representative female worker can expect to receive if employed. A positive relationship is expected between hours worked and average earnings.

(2) Income (CI)[4]

Average weekly total earnings of other household members is taken as a measure for the income variable[5]. It can be assumed that this is a male wage rate and is an index of the prosperity of the governerates. There is no data available on unearned income which might include cash income or assets.

The effect of male earnings and assets as a source of other income cannot be investigated.

However, it is reasonable to assume that the impact of this measure of other income is more appropriate for married rather than single females. This could be the case for widowed females receiving pensions or divorced/separated females receiving maintenance. The data indicates that 33% of households report no cash income. For married females this is just under 30% and for single females this is over 40%. This seems to be in agreement with the remarks made in the previous paragraph.

Income also acts as a control variable in that households reporting no cash income are excluded from the analysis. However, if income is considered to be an eondogeneous variable, that is earnings of other household members is affected by the work status of the individual, then the coefficient estimates are biased (as stated in Chapter III).

(3) Unemployment (UN)

The measure for the unemployment variable is the number in the labour force classified as unemployed to the total number in the labour force (the LFS also distinguishes between those unemployed with previous work experience and no work experience). This ratio represents the availability of jobs or job opportunities in general. The effect of unemployment on participation can either be positive or negative depending on

the relative strength of the added-worker and discouraged-worker effect. However, if the unemployment rate is viewed as the probability of finding a job by the labour force entrant, then we would expect the discouraged-worker effect to prevail[6].

(4) Fertility (CPW, FMZ)

The original data set does not assign to each female the number and ages of children in the household. However, from the household data twelve children variables were created so that to each ever-married female the number of children in each single year age group from one to twelve were assigned[7]. Two measures of fertility were used:

(a) For single females, average family size is used, and (b) for married females the ratio of the number of children aged less than five years to the number of married females aged 25-49.

Both these measures suffer from the defect that child mortality is not taken into account. The results of the 1980 Egyptian Fertility survey suggest that when the numbers of living children are compared between regions, fertility differences are reduced. Child mortality rates (children aged less than five years) in Upper Rural Egypt are highest (252 deaths per 1000 live births) and lowest in Urban Lower Egypt (145 deaths)[8]. So that, although the largest family sizes are found in Lower Egypt, Upper Egypt has more live births, (but also a higher child loss). In this study, reporting of live children is expected to be a more accurate measure than

children ever born, the effect of the variables on hours and participation is expected to be reduced.

(5) Schooling (ED)

The measure taken for schooling is the proportion of females with educational attainment higher than primary level (compulsory level). The expected relationship between schooling and labour force participation is positive for reasons stated earlier: a higher level of schooling means higher expected earnings and accessibility to better jobs. The aggregate measure thus acts as an index to the factors mentioned. Another factor explaining the expected positive relationship is that continued schooling is closely related to aptitude for work and probably increases motivation towards work. In this case the aggregate measure acts as an index to the propensty to and acceptability of work for females. For, it can be argued, if females are willing and allowed to continue education beyond the compulsory level, then this will also admit them to market work.

4.2.2 Procedure of estimation

The relationship between the set of variables described in the previous section and labour supply, measured by hours worked (workers and all females) and labour force participation is analysed through a set of inter-governerate regressions (for urban areas).

As stated before, the border regions are inhabited by less than

1% of the labour force population. On this basis the researcher used the governerates of Upper and Lower Egypt as the main subset. However, for the sake of comparison, a sample of all governerates is also used.

In addition to an inter-governerate analysis, two other procedures were also considered by the researcher. The first procedure would involve estimating separate functions for the governerates of Upper and Lower Egypt respectively. This was not favoured since it would involve a reduction in sample size.

For the second procedure, separate functions would be estimated for urban and rural areas. It seems justified to either treat urban and rural areas separately or to include an area variable that differentiated between these areas. First of all there is underenumeration of females in rural areas, particularly those engaged in agricultural activity. Secondly, the seasonal nature and average longer hours of those engaged in agriculture would provide a good case for the exclusion or separate treatment of rural areas.

For these reasons it was decided to analyse urban and rural areas separately. However, a number of trial regressions for rural areas (and also trails using an indicator for type of area) provided insignificant results (as measured by the t-ratios and R^2, the coefficient of multiple correlation). Therefore, certain criteria were adopted to exclude the agricultural sector from the analysis.

The hours function for working females is estimated for a sub-group of females engaged in non-agricultural activities. However, when using the group of participants and non-participants, another

criterion had to be used so that the agricultural sector in the economy is excluded. For this reason, a sub-group of females in urban areas is used. For the sample of all females there was also an additional problem; nearly 33% of the females in the sample living in urban areas reported no household cash income (compared to 54% of those living in rural areas). These households were excluded from the analysis. Again for the sake of completeness a sample of all females for all income levels is used.

The labour force is defined as the number of persons who are working or seeking work during the reference week of the survey(9). The classification of whether a person is in the labour force is decided by comparing the answers provided by the respondent with the criteria set by those carrying out the survey(10).

The most direct measure for the estimation of the hours function of working females is the average hours worked per week for each governerate. However, a sub-group chosen on the basis of the individual's work status (an endogeneous variable) is not a random sample. Overall, the error term for the workers is expected to be positive, reflecting higher tastes for work, a factor that is contained in the error term (this is discussed in Chapter III). If the magnitude of the bias is considered to be of importance, an estimation procedure can be used to obtain the true estimates(11).

For the hours function of all females a value of zero hours worked is given to non-working females before aggregation. Considering the large number of non-working females, this measure of labour supply, to a large extent, reflects the degree of labour

force participation. Thus, the hours of work functions and participation functions are expected to provide similar results[12].

The third dependent variable used is the participation rate for each governerate. This is defined as the proportion of females who are in the labour force to the total population under study. If an assumption is made that the age distribution of the governerates are fairly similar to each other, no consideration of the age factor is required. If this is not the case, then age becomes a determinant factor in the participation rate.

Two procedures are possible:

(1) A participation rate adjusted for age can be used[13].

(2) A sub-group that excludes the older sector of the population is used (containing those aged 25-49 years).

Although the age distribution of the population is not used, use is made of the geographical distribution of the population. The use of population weights to reduce heteroscedasticity in regression residuals was adopted by Bowen and Finegan [1969][14]. However, their findings indicate that weighted regressions produced similar results to ordinary least squares. In this study, weighted regression analysis is used to compare results with those of ordinary least squares regression; the population weight used was that adopted by Bowen and Finegan:

$$\sqrt{P_i / \sum_i P_i}$$

where:

P_i : population in governerate

$\sum_i P_i$: total population

Finally, for the sake of convenience, a list of the sub-groups used, as well as the functional form of the equation (if not linear) and estimation method (if not OLS) is presented below:

1: Main sub-group; the governerates of Lower and Upper Egypt. For the function using all females (workers and non-workers) those with no reported household cash income are excluded.

1L: Main sub-group; logarithmic functional form.

2: The all-region group; the governerates of Lower and Upper Egypt and the Border Regions.

2L: The all-region group; logarithmic functional form.

3: 25-49 sub-group.

1W: Main group, weighted regression.

1I: All-income group.

S: All single females.

N: Never-married females.

H: Married females, head of households.

D: Divorced females.

W: Widowed females.

Before examining the performance of the model, clarification of the presentation of the results is needed. Stepwise procedure in regression analysis is used to estimate the hours and participation functions. Using this procedure two measures are available to evaluate the importance of the explanatory variables; the level of significance (t-ratio) and the contribution of the variable to the

coefficient of multiple correlation (R^2). Added to this, since some of the variables in the equation were found to be statistically insignificant, it is felt that this presentation is concise. However, the sign of the coefficients of these variables are of interest. These coefficients are included in the results, but placed in brackets. The contribution of the significant variables to (R^2) is indicated below their coefficient estimates.

4.3 Results for Married Females

The results for married females are presented in tables (4.4) to (4.6). The results for the main sub-group indicate that for the hours functions the set explanatory variables explain at least half the variation and hours worked between governerates and nearly thirty percent of the variation in participation rates between the governerates. However, consideration of the inherent biases discussed earlier should be kept in mind when interpreting the results.

For working females, the set of explanatory variables is significant for all sub-groups. For the main sub-group, the equation explains about half (.52) of the variation in hours worked between governerates; and the regressions are significant as indicated by the significance level of the F-ratio (indicated above the R^2 value). As expected, results for the hours function for all females and the participation function provide similar results; namely the predominance of the education variable, and all regressions are significant (F ratio). Although weighted least squares regression provides better results (as measured by R^2), the coefficient estimates for the education variable are very similar

for both the hours and participation functions. The 25-49 age sub-group also provided nearly identical coefficient estimates as for the main group. And, as expected, the explanatory power of the model is greater when applied to the all-region group.

The remaining part of this section examines the effect of each variable on the work behaviour of married females.

In all three functions, the contribution of the education variable to the explanatory power of the model is the greatest (except for the all-region group for working females). The results indicate, for working females, an increase in the average work week of one hour for a governerate having .05 of the proportion of workers with at least an intermediate degree higher than the national average. The corresponding result for the all hours function indicates an increase of nearly one and a half hours in the average work week. For the participation function the participation rate is nearly five percent higher than the national average.

It is worth noting that the difference in participation between the governerates is determined in nearly all the functions by the education variable only. For the hours function, at least, although education can be considered a predominant factor, the average work week is determined by other factors as well. The predominance of the education variable may be partly attributed to the primary role of education in securing government jobs (or more pleasant jobs) and the expected association between education and wages. Higher education would also seem to indicate a greater preference towards market work.

Monetary incentives as determinants of labour supply are indicated by wage and income elasticities and coefficient estimates.

The sign of the coefficient estimate of the wage variable is statistically significant in all the functions for workers, although the sign of the coefficient estimates is not uniform (both signs are compatible with the theory). However, the magnitude of the coefficient estimates are small (ranging from -.004 to .004) and this is reflected in the measure of the total wage elasticity (which is the coefficient estimate in the logarithmic equation). The responsiveness of hours worked to increases in the wage is weak; ranging from -.22 to .23; indicating an inelastic response of hours to gross wages. The coefficient estimates in the all-hours function are positive (when statistically significant), but again the elasticity of total wage to hours in this group is less than one (.49). This is also the case in the participation functin where total wage elasticity has a slightly higher value of .54.

The results also show that the average work week is reduced by one hour in a governerate with an average wage of E£2.5 higher than the national average (main group 1). The corresponding increase is nearly three and a half hours and ten percent in the all-hours and participation functions respectively.

The coefficient estimates for the income variable (in the workers function) are negative in sign; and, statistically significant for the all-region and economic equations. As for the wage variable, the magnitude of the coefficients are small; -.004 and -.003; with corresponding income elasticities of -.54 and -.17. The all-hours function indicates the expected negative coefficient

estimates, but is statistically significant only for the all-region group; for the participation function the sign of the coefficients are negative, but statistically insignificant. The results from these two functions show an inelastic response of hours and participation to income (-.1 and -.13 income elasticities). The results show that the average work week is reduced by about one hour in a governerate with an average income of E£2.5 above the national average.

The effect of the presence of young children reduces the hours worked for workers. The coefficient estimates are negative and statistically significant in all the function for workers. A governerate which has a child per woman ratio of .1 (10 children per 100 females aged 25-49) higher than the national average has a reduction in the average work week that is between roughly three-quarter to one and a half hours. The elasticity of the fertility variable with hours worked is -.17 to -.53 indicating a small responsiveness of workers to the presence of young children. The coefficient estimates in the all hours and participation functions are positive (although not statistically significant) in almost all the equations, suggesting that female participation in a governerate rises with a higher child per woman ratio. The conclusion reached from these results is that fertility measures do not explain the variation between governerates, i.e., fertility is not a determinant of participation, or that the omission of child mortality in the child/woman ratio caused an error in measurement.

Finally, the coefficient estimates for unemployment have a negative (those statistically insignificant) sign in all functions,

Table 4.4 Hours function for Working Married Females, non-agricultural activities

Explanatory Variables / Sub-group	W	CI	ED	CPW	Intercept	R^2
1	$-.004^{***}$	(-.23)	20.7^{***}	-8.6^{***}	36^{***}	$.52^{***}$
	$(.35)^2$		$(.27)^1$	$(.53)^3$		
1L	$-.22^{***}$	(-.25)	$.41^{***}$	$-.17^{***}$	5.3^{***}	$.51^{***}$
	$(.35)^2$		$(.25)^1$	$(.51)^3$		
2	$.002^{***}$	$-.004^{***}$	7.4^{*}	-15^{***}	51^{***}	$.73^{***}$
	$(.69)^3$	$(.57)^2$	$(.73)^4$	$(.34)^1$		
2L	$.23^{***}$	$-.52^{***}$	(-.1)	$-.53^{***}$	5.8^{***}	$.67^{***}$
	$(.67)^3$	$(.54)^2$		$(.23)^1$		
3	$-.004^{*}$	(-.12)	20^{***}	-7^{*}	35^{***}	$.43^{***}$
	$(.33)^2$		$(.24)^1$	$(.43)^3$		
1	$.004^{*}$	$-.003^{*}$			38^{***}	$.10^{**}$
1L	$.13^{*}$	$-.17^{*}$			3.7^{***}	$.06^{*}$

***, **, * significant at the 1%, 5% and 10% level.

Figures in brackets below the coefficient estimates are the R^2 values. The number above the brackets denotes the order of entry into the equation.

Table 4.5 Hours function for all Married Females, urban areas

Explanatory Variables / Sub-group	W	CI	ED	CPW	UN	Intercept	R^2
1		(-.22)	.28*** (.54)[1]	(.15)	(-.18)	1.7	.54***
1W		(-.09)	.27*** (.84)[1]	(.16)	(-.03)	.19	.84***
1I		(-.09)	22*** (.24)[1]	(.1)	(-.3)	2.2	.24**
2		-9.3** (.75)[2]	.30*** (.68)[1]	(.8)	(-8)	4.1	.75***
3		(-.23)	.29*** (.57)[1]	(.08)	(-.13)	1.7	.57***
1	(-.35)	(-.21)	.8*** (.54)[1]	(.15)	(-.18)	1.6	.54***
1	.013*** (.46)[1]	(-.14)				2.7***	.46***
1L	.49*** (.61)[1]	(-.1)				-.9***	.61***

***, **, * significant at the 1%, 5% and 10% level.

Figures in brackets below the coefficient estimates are the R^2 values. The number above the brackets denotes the order of entry into the equation.

Table 4.6 Participation function for Married Females, urban areas

Explanatory Variable / Sub-group	W	CI	ED	CPW	UN	Intercept	R^2
1		(-.12)	.76** (.26)[1]	(.2)	(-.3)	.05	.26***
1W		(-.12)	.72*** (.66)[1]	(.18)	(-.17)	-	.66***
1I		(-.08)	(.21)	(-.02)	-1** (1.17)[1]	.24	.17**
2		-.19	.9*** (.49)[1]	(.17)	(-.17)	-	.49***
3		(-.1)	.76*** (.31)[1]	(.13)	(-.3)	.05	.37***
1	(-.5)	(-.21)	.76*** (.26)[1]	(.2)	(-.3)	.05	.26**
1	.0004** (.19)[1]	(-.02)				.07*	.19**
1L	.54** (.45)[1]	(-.13)				-3.8	.43***

*, **, ***, significant at the 10%, 5% and 1% level estimates

Figure in brackets below the coefficient estimates are the R^2 values. The number above the brackets denotes the order of entry into the equation.

indicating the prevalence of a discouraged worker effect. The only exception is the all-income group in the participation function. A governerate with an unemployment rate that is one percent above the national average has a lower participation rate of one percent lower than the national average.

4.4 Results for Single Females

The results for single females are presented in tables (4.7) to (4.9). The analysis is carried out for the sub-group of single females, i.e., those females who are classified as never-married, married with husband absent, divorced or widowed. The hours for the working females function is estimated only for never-married females and for married females who are household-heads. The results obtained for the sub-groups of divorced, widowed and all single females provided insignificant results (measured by the R^2 value and t-ratios). The hours function for all females and the participation function are also estimated for each of the marital status categories separately, as well as all single females.

For the sub-group of workers the model explains as much as a third of the variation between the governerates, for never married females; and over forty percent of the variation for married household heads. The explanatory power of the model (measured by the R^2 value) is not as great for these two sub-groups of single females as for married females.

For the all-hours and participation functions the model explains between one quarter to over ninety five percent of the variation between the governerates. The results also indicate that

the R^2 value is lower for the separate marital sub-groups than for the all single group. Overall the results for these two functions are considered good.

The remaining part of this section examines the effect of each variable of the work behaviour of single females.

Education is considered, overall, the most important determinant factor in the work behaviour of single females. For workers the coefficient estimates are statistically significant for the sub-group of never-married females. However, the sign of the education variable is negative, indicating that the average work week is reduced by up to one hour for a governerate having .05 of the proportion of workers with at least an intermediate higher than the national average.

The coefficient estimates for the all-hours function are positive and statistically significant except for the sub-group of never-married females. The average work week increases by two to four hours in a governerate having .1 of the proportion of workers with at least an intermediate degree higher than the national average. The corresponding increase in the participation rate is about 6 to 11 percent. The results for never-married females show a corresponding increase of 1.5 to 2 hours in the average work week and around 6% in the participation rate; for married heads of households there is an increase of about 2 hours and 6%; for divorced females 4 hours and nearly 10% and for widowed females 3.5 hours and over 6%. Thus among single females, never-married females indicate the least responsiveness to the education variable.

Average family size in a governerate is considered to be the

second most important determinant of the work behaviour of single females. The coefficient estimates are negative when statistically significant. This is the case for the sub-group of never-married females in the workers function, all-hours function and participation function; and; the all-single group in the all-hours and participation functions.

For never-married females, a governerate with an average family size of one individual above the national average reduces the average work week by between two hours. The corresponding reduction in the all hours function is five hours and in the participation function six percent. For all single females the corresponding reduction is one to three hours, and three to five percent in the all-hours and participation functions respectively. An increase in this ratio of 1 child per thousand women in a governerate increases the average work week by nearly one and a half to two hours.

Overall, the monetary variables are not significant determinants of the labour supply of single females. The estimates of the wage coefficients are statistically insignificant, except in the economic equations which are presented in tables (4.8) and (4.9). The results show a positive, but small (less than 1) elasticity of total wages to hours and participation. The income coefficient estimate is statistically significant for household heads; having a negative sign as predicted by theory, and also being very small in magnitude. The income elasticities (obtained from the economic equations) are -.21 and -.12; again demonstrating a lack of responsiveness of labour supply to the changes in average cash income between governerates.

Finally, the unemployment variable, although not uniformly significant, shows statistically significant coefficient estimates for all sub-groups except never-married females. For the hours function for single females a positive difference in the unemployment rate of .01 increases the average work week by about 1 hour; for married household heads the increase is nearly 5 hours and for divorced females there is a decrease of 2 hours. Similar results are found for the participation function, i.e., a positive or added-worker effect of unemployment on participation. The corresponding increase in participation for a difference of 1% in the unemployment rate is 7% for married heads of households and 3% for widowed females. These results are in contrast to those obtained for married females, where a discouraged-worker effect is exhibited.

Table 4.7 Hours function for working Single Females, non-agricultural activity

Explanatory Variable / Sub-group	W	CI	ED	CPW	FMZ	Intercept	R^2
N1	(-.1)	(-.001)	-20** (.21)[1]		-1.9* (.29)[2]	66***	.29**
N2	(.08)	(-.3)	-14** (.13)[1]		(-.3)	51***	.13**
N3	(-.06)	(-.03)	-21*** (.24)[1]		-2** (.34)[2]	68***	.34***
H1	(.03)	(.004)	(-.2)	13*** (.44)[1]		31***	.44***
H2	(.03)	(.004)	(-.2)	14*** (.44)[1]		31***	.44***
H3	(.17)	(.02)	(.06)	19*** (.44)[1]		26***	.44***

***, **, * significant at the 1%, 5% and 10% level.

(Figures in brackets below the coefficient estimates are the R^2 values. The number above the bracket denotes the order of entry into the equation).

Table 4.8 Hours function for all Single Females, urban areas

Explanatory Variables / Sub-group	W	CI	UN	ED	FMZ	Intercept	R^2
S1		(.05)	12.8** (.66)[3]	24*** (.48)[1]	-2*** (.59)[2]	4.7**	.66***
S1W		(-.003)	(.07)	41*** (.97)[1]	(.06)	(.2)	.97***
S1I		(.17)	(.26)	26** (.47)[1]	(-.1)	4***	.47***
S2		(.04)	(.01)	24*** (.63)[1]	-.9* (.68)[2]	11.7***	.68***
S3		(-.06)	(.26)	20** (.55)[2]	-2.9** (-41)[1]	27***	.55***
N1		(-.11)	(-.18)	(.31)	-5** (.25)[1]	51***	.25**
H1		-.003*** (.11)[1]	48*** (.39)[2]	19* (.48)[3]	(-.13)	18***	.48***
D1		(.02)	-21*** (.58)[2]	41*** (.23)[1]	(.01)	8**	.58***
W1		(.2)	(.2)	35** (.25)[1]	(.25)	5***	.25**
S1L	.26** (.22)[1]	(-.21)				.9	.22**

***, **, * significant at the 1%, 5% and 10% level.

(Figures in brackets below the coefficient estimates are the R^2 values. The number above the bracket denotes the order of entry into the equation).

Table 4.9 Participation function for Single Females, urban areas

Explanatory Variables / Sub-group	W	CI	UN	ED	FMZ	Intercept	R^2
S1		(.09)	(.2)	$.7^{***}$ $(.6)^1$	$-.04^{**}$ $(.67)^2$	$.4^{***}$	$.67^{***}$
S1W		(.005)	(.01)	1.1^{***} $(.98)^1$	(.1)	$.007^{**}$	$.98^{***}$
SI		(.19)	(.22)	$.62^{***}$ $(.70)^1$	-.05	$.14^{**}$	$.70^{***}$
S2		(.01)	(-.07)	$.66^{***}$ $(.69)^1$	$-.03^{**}$ $(.75)^2$	$.33^{***}$	$.75^{***}$
S3		(-.01)	(.21)	$.68^{***}$ $(.67)^1$	$-.04^{**}$ $(.73)^2$	$.44^{***}$	$.73^{***}$
N1		(-.08)	(.09)	$.62^{***}$ $(.58)^1$	$-.06^{**}$ $(.69)^2$	$.56^{***}$	$.69^{*}$
H1		$-.00005^{**}$ $(.56)^3$	$.74^{***}$ $(.39)^2$	$.63^{***}$ $(.31)^1$	(.09)	$.37^{***}$	$.56^{***}$
D1		(-.09)	(-.11)	$.97^{***}$ $(.76)^1$	(0.5)	$.14^{***}$	$.76^{***}$
W1		(.22)	$.28^{**}$ $(33)^2$	$.62^{**}$ $(.21)^1$	(.05)	$.09^{***}$	$.33^{**}$
S1L	$.25^{***}$ $(.30)^1$	(-.12)				-2.6^{***}	$.30^{***}$

***, **, * significant at the 1%, 5% and 10% level.

(Figures in brackets below the coefficient estimates are the R^2 values. The number above the bracket denotes the order of entry into the equation).

4.5 Estimation Procedure and Definition of Variables

The most accessible data source available and the easiest to utilise is published census data. Early labour supply studies such as those of Mincer (1962) and Bowen & Finegan (1969) used census data for aggregate cross-section studies. And, as Cain (1966) pointed out, there are some empirical advantages in using aggregations - such as the elimination of transitory factors in income data - even though it is theoretically more plausible to use disaggregated data.

Apart from being a source of comparison to results obtained from the LFS study, a census study using published data indicates the ease of adaptability and usefulness of this type of data to labour force studies in Egypt.

The first data restriction of the census source is the inability to analyse by reference to marital status. The procedure of estimation therefore uses the participation rate of all females. There are two measures for the dependent variable:

(1) Work status (those aged six years and over).

(2) Occupational status (those aged fifteen years and over).

An inter-governerate analysis is applied to all governerates and, as in Part I, to those governerates of Upper and Lower Egypt

(excluding the Border regions). The analysis is also applied to urban areas and rural areas separately. The justification of inclusion of a set of regressions for rural areas lies primarily in that reasonably good results were obtained.

The set of explanatory variables used to explain labour force participation are:

(1) LFW: The logarithm of average female weekly earnings 1977 LFS.

(2) LMW: The logarithm of average male weekly earnings 1977 LFS.

(3) UN: The proportion of males aged 6 years and over who are in the labour force and unemployed.

(4) ED: The proportion of females aged 15 years and over who have reached the intermediate level of education.

(5) MRR: The proportion of females who are married.

(6) CH1: The proportion of the total population aged less than 1 year of age.

(7) CH2: The proportion of the total population aged 1-4 years.

(8) CH3: The proportion of the total population aged 5-9 years.

(9) CPW: The raio of children aged under 5 years to females aged 25-49 years.

(10) MIG: The proportion of the residents in the total population who are migrants.

The effect that some of these variables have on the participation decision has already been explained in Part I. The remainder of this section will expand on the definition and expected influence on the participation rate of those variables not previously discussed.

The Proportion of Females Married (MRR)

Fertility and labour force participation are both affected by marriage and in a more general household model, marriage decisions are made jointly with decisions affecting family size and market participation. The adopted measure for this variable is the proportion of females in each governerate who are married. This measure reflects the greater demand for home time or alternatively, is an indirect measure of the labour supplied by single females who have a higher market participation rate.

Fertility Variables (CH1, CH2, CH3, CPW)

The hypothesis that the demand on female time at home is greatest for pre-school children can be examined through the three variables CH1, CH2 and CH3 exerting a deterrent effect on the labour force participation rate for the two youngest age groups (CH1, CH2). Another measure used is the child per woman ratio (used in Part I).

Migration

Migration is viewed as an investment activity undertaken when the return outweighs the cost involved (Nerlove and Schultz, 1970).

It is argued that females, if equally educated as males, may have more to gain from leaving traditional rural areas for opportunities in urban areas. This would imply that migration to a governerate is directly related to the labour force participation rate. However, we are in this case assuming an equal age-sex distribution in migration. This most probably is not the case since it is usually young people who migrate. For this measure, though, it will be assumed that the sexes are equally present. However, the influx of migrants might also result in a decline of the availability of jobs, implying a direct negative effect on female participation. The overall effect of migration, therefore, cannot be determined theoretically.

4.6 Results from Census Data

The results for the labour force participation of females are presented in tables (4.10) and (4.11)[15].

Least squares regression indicate a good fit to the participation function, as represented by R^2, the coefficient of multiple correlation. The equation explains between 70% and over 90% of the variation in the participation rate between governerates. The signs of the coefficient estimates for the two dependent variables are in agreement (see table 4.11), while the magnitude of the estimates are similar in most cases. The equations for urban areas are a better fit than those for rural areas, but it can be said that all the results are good. The remainder of this section is concerned with the analysis of the effect of each variable on participation.

Female wages do not exert a significant effect on the participation rate. However, the sign of the coefficient estimates are positive as expected (except in one case). The coefficient estimates for male wages are statistically significant (at least in one equation) and exert a negative (income) effect on the participation rate.

The coefficient estimate for the education variable is statistically significant in all the functions indicating, as in Part I, its primary importance. The sign of the coefficient estimate is, as expected, positive. The increase in the proportion with intermediate educational level of .1 above the national average in a governerate raises the participation rate by between 7-13% in urban areas and all areas; the corresponding affect is greater in rural areas where the increase is by as much as 25%.

The deterent effect on participation of the marital status variable is statistically significant in most functions. A governerate with a .1 rate higher in the proportion married above the national average has a lower participation rate by nearly 3%. The effect is more pronounced in rural than urban areas.

The coefficient estimates for the fertility variables are not statistically significant, overall, in the regressions for the governerates of Lower & Upper Egypt only. From the results for all governerates of Egypt, statistically significant coefficient estimates are obtained for the separate area regressions. For urban areas, the demand for home time of younger age children (CH2) has a positive effect on participation, while the income demands of older age children (CH3) have a negative effect on the participation rate.

A .1 (absolute) increase in the proportion of children aged 1-4 years above the national average lowers the participation rate by about 10% - the corresponding rate is 15% for the CH3 variable.

In the rural regressions the effect is negative on the participation rate only for the variable CH1, showing an increase in the rate for the variables CH2 and CH3. A .1 increase in the proportion of children aged less than one year above the national average reduces participation by 11%, the corresponding increase is about 4.5% and 4% for CH2 and CH3 respectively.

Finally, in terms of the magnitude of the coefficient estimate and the significance level of the t-ratio, the effect of migration on the participation rate in a governerate is negligible. This could be the result of the inadequacy of this measure for migration. Alternatively, a higher migrant participation rate could be offset by a resulting lower resident female participation rate.

Table 4.10 Labour Force Participation of Females Lower & Upper Egypt, 1976

Area	All Areas		Urban Areas		Rural Areas	
Explanatory Variables	D1	D2	D1	D2	D1	D2
LWF	.012	.011				
	(1.19)	(1.15)				
LMW	-.021	-.02				
	(1.66)	(-1.86)*				
UN	-.34	-.29	.05	.11	-.71	-.94
	(-1.04)	(-1.19)	(.1)	(.25)	(-1.53)	(-2.7)
ED	1.15	1.13	1.2	1.2	2.6	1.89
	(6.15)***	(10.5)***	(4.63)***	(5.78)***	(4.48)***	(4.28)***
MRR	-.23	-.19	-.02	.15	-2.53	-.19
	(-2.43)**	(-2.57)**	(-.09)	(.92)	(-.21)	(-2.8)***
CH1	.68		1.74		-1.24	
	(.8)		(1.1)		(-1.2)	
CH2	.09		-1.18		.58	
	(.23)		(-1.73)*		(1.41)	
CH3	.22		1.15		.25	
	(.44)		(1.19)		(.59)	
CPW		.02		-.04		.002
		(.89)		(-1.12)		(.08)
Intercept	.19	.20	-.02	-.04	.09	.17
	(1.89)*	(2.86)**	(-.16)	(-.37)	(.95)	(.06)
R^2	.95	.96	.78	.78	.7	.7

***, **, * 1%, 5%, 10% level of significance.

Table 4.11 Labour Force Participation of Females, all Egypt 1976

Area	All Areas		Urban Areas		Rural Areas	
Explanatory Variables	D1	D2	D1	D2	D1	D2
LMW	$-.5x10^{-3}$	$.2x10^{-4}$				
	(-.37)	(1.1)				
LFW	$.6x10^{-4}$	$-.1x10^{-3}$				
	(.63)	(-.9)				
UN	-.68	-.5	.16	.31	-.75	-.55
	(-2.7)**	(-1.7)*	(.68)	(.9)	(-5)***	(-4)***
ED	.73	1.1	.86	1.3	1.1	1.1
	(4.8)***	(6.2)**	(5.9)***	(5.9)***	(2.5)**	(4.9)***
MRR	-.2	-.31	-.03	-.13	-.2	-.1
	(-3.2)***	(-3.7)***	(-.51)	(-1.3)	(-3.4)***	(-2.9)***
CH1	-.8	-.47	.46	1.3	-1.1	-.83
	(-1.4)	(.7)	(.082)	(1.5)	(2.5)**	(-2)*
CH2	.26	.2	-.3	-1.1	.45	.37
	(.96)	(.6)	(-.8)	(-2)**	(2.5)**	(2.3)**
CH3	.44	.28	.7	1.5	.42	.23
	(1.46)	(.8)	(1.6)	(2.2)**	(2.2)**	(1.3)
MIG	-5x10-5	.001				
	(-.06)	(1.3)				
Intercept	.08	1.3	-.08	-.06	.02	.02
	(1.2)	(1.6)	(-1.1)	(-.56)	(.6)	(.5)
R^2	.90	.95	.82	.87	.73	.81

***, **, * 1%, 5%, 10% level of significance.

NOTES:

1. In Chapter 8, Ikram (1980) expands on some of the detrimental consequences of high urbanisation, such as poor housing conditions, shortage of housing and the deterioration of urban services (e.g., transport and education) which have a direct effect on participation and hours.

2. See Ikram (1980), table (8.2). Seatherum [1983] also gives a discussion about internal migration and urbanisation:pps. 33-53.

3. This seems to indicate that the change in enumeration of females in the LFS (from 1983) concerned rural areas rather than urban areas.

4. This variable is not available on the original data set. The researcher created the variable by using a fortran program selecting each individual (apart from the female) that belonged to the same household, and summing their earnings.

5. Wages make up 70% of income. See Rees (1979).

6. See Bowen and Finegan (1969), pp.76-78 and pp.178-90 for married females.

7. In earlier trials each of the child variables were used, but only those variables for children aged less than five years were found to be significant.

8. Rural areas are excluded from the analysis for the sample of all females, so the variation is less since the child mortality rate for urban Upper Egypt is 193.

9. This definition is widely used and accepted. But, as pointed out in many studies (for example, Bowen & Finegan [1969]), this definition encompasses paid workers only, even though they might work a minimal number of hours, while excluding many who work long hours for no pay such as housewives.

10. The questions about participation refer to work status on the 4th May, 1984, the hours and number of days worked during the reference week.

11. The estimation procedure proposed by Heckman [1980], relies firstly on probit estimates for the participation function. Unfortunately the computer package used by the researcher, SPSS-X, could not be adapted to produce probit estimates for the aggregate function.

12. Although, as stated before, the estimates of the sample of the whole population will not suffer from selectivity bias, specification errors (most notably due to the omission of a migration measure) might arise.

13. This has been used earlier, showing adjusted rates to be very close to unadjusted ones.

14. Heteroscedasticity arises when the OLS assumption of constant variance of the residuals is violated; a situation that often arises in practice. A discussion of this problem and its consequences is found in Koutsoyiannis [1986]: pp.181-185.

15. Results for males; which can be used for comparison, but are not analysed in this section, are presented in Appendix II, table A4.1.

CHAPTER V: INDIVIDUAL STUDY

In Chapter III the participation decision of an individual was assumed to rely on two behavioural functions; the offered (or market) wage and the asking wage (or shadow price of time). A female participates if the value of the offered wage function exceeds that of the asking wage function at zero hours worked. In the first part of this Chapter, an empirical procedure based on this approach (discussed in section 3.2) is applied to individual cross-section data from the 1984 LFS. The aim of this empirical procedure is to obtain the structural coefficient estimates for the offered wage and asking wage functions. Hours functions for workers and for all females are also estimated and a test for selection bias in the offered wage function and the hours of workers is applied. Finally, Heckman's proportionality hypothesis is also tested.

The second empirical application examines a number of procedures that could be used to test the joint-determination of household decisions discussed in Section 3.3.1 of Chapter III. Estimation of simultaneous equation systems present a number of problems. There is no theoretical guidance on model specification. And, once the model is specified, there is the problem of the appropriate estimation procedure. Two models are presented and empirically examined. The data used is individual cross-section data from the 1980 EFS. In the analysis the group of once-married females is used.

5.1 Introduction

The empirical procedure in Part I uses individual data from the 1984 LFS with Cairo as the area of analysis. Although Cairo represents the most urbanised area in Egypt, it is a city of contrasts: it can be assumed that the lifestyle and economic activity of those living in the old part of Cairo (founded in the wake of the Islamic conquests in the seventh century) differs from those in the newer part of Cairo (Giza and Heliopilis) which were established during this century. Cairo is the political, municipal and cultural centre of Egypt, with a population of over five million persons (5,074 thousand) in 1976 and containing 14% of Egypt's population. Those in the labour force (aged 15 years and over) are numbered at nearly one and a half million persons (1,430 thousand) which accounts for 13.9% of the total labour force in Egypt. The number of females working in Cairo is counted as 189,509 females, which amounts to 27% of the total female labour force.

The remaining part of this introduction examines the characteristics of the two sub-groups of females: married and single females.

Table (5.1) shows the participation rates for the different marital groups. The difference in the participation rates between the two main sub-groups, married and single females, reflects the increased demand on the time of a married female who performs the dual role of mother and wife. Among single females there is also a large difference in participation rates indicating that marital status is also an important factor for this group. The participation rate is highest for never-married females (60.3%).

Table 5.1 Marital Status and Labour Force Participation of Females, Cairo and Urban Egypt, 1984

Marital Status	Number in Sub-group	Number in Labour Force	Participation Rate
Married, husband present	3882 (13482)	500 (1787)	12.9 (13.3)
Single	1622 (4440)	547 (1316)	33.7 (29.6)
Never-Married	562 (1413)	339 (770)	60.3 (54.5)
Married, Head of Household	303 (719)	73 (166)	24.1 (23.1)
Divorced	129 (305)	42 (93)	32.9 (30.5)
Widowed	628 (2003)	93 (287)	14.8 (14.3)

Figures in brackets are those for Urban Egypt.

As pointed out by Bowen & Finegan (1969, p.244), an explanation for such a high rate among never-married females is a stronger drive to labour force participation either as the result of financial necessity because of the lack of support or as the result of strong career interest.

The prevalent situation in Egypt, whether as a result of cultrual or religious reasons, indicates that never-married females (and most probably many who constitute the other categories of single females) belong to some form of an extended family group. Table (5.2) shows the classification of those who are single females by family status. Nearly 85% of this sub-group are classified as either being household head or daughter, i.e., belonging to a nuclear family. The incidence of a single female living alone is not very high as indicated by family size suggesting that the financial pressure explanation might be less important for single females in Cairo compared to their western counterparts. The demand for time for the different marital groups in the single sub-group might also be different in an extended family group; family status might be considered an important determinant factor in female labour force participation.

The remaining part of this section examines the life-cycle participation pattern of females.

Table (5.3) presents the age-participation profiles for married females and figures (5.1 and 5.2) depict these profiles. There is no uniformity in the peak age of participation. However, the EFS and LFS profiles display a difference. The EFS profiles show that participation peaks relatively early in the life-cycle, after which

Table 5.2 Family Status of Females Categorised as Single, Cairo, 1984

Family Status	Number in Sample	Percentage of Sample
Household Head	870	44.9
Daughter	707	36.5
Daughter-in-law	108	5.6
Sister	97	5.0
Sister-in-law	6	.3
Mother	85	4.4
Other Relation	35	1.8
Visitor/Worker	6	.3

Table 5.3 Age-Participation Profiles, Married Females

Area / Age-Group	Urban[1]	Rural[1]	Cairo[1]	All Areas[1]	Urban[2]	Rural[2]	Cairo[2]	All Areas[2]
15-19	6.4	6.7	-	6.5	3.5	11.4	8.7	8.9
20-24	15.2	14.4	11.5	14.3	9.9	15.8	3.3	13.5
25-29	17.9	17.5	15.7	17.8	19.6	18.9	19.1	19.2
30-34	18.1	15.7	14.4	17.3	17.4	24.7	22.7	21.2
35-39	15.8	16.2	17.3	15.9	15.3	16.2	18.8	15.8
40-44	14.1	16.3	15.3	14.8	12.3	13.6	22.6	12.9
45-49	9.0	15.3	8.8	11.4	9.7	9.0	11.8	9.4
50-54	6.0	13.4	8.2	8.8	-	-	-	-
55-59	4.6	9.6	3.8	6.5	-	-	-	-
All	13.2	15.1	12.8	13.9	14.3	16.9	16.7	16.7

1 1984 LFS

2 1980 EFS
- not applicable

Figure 5.1 Age-Participation Profiles of Married Females, LFS.

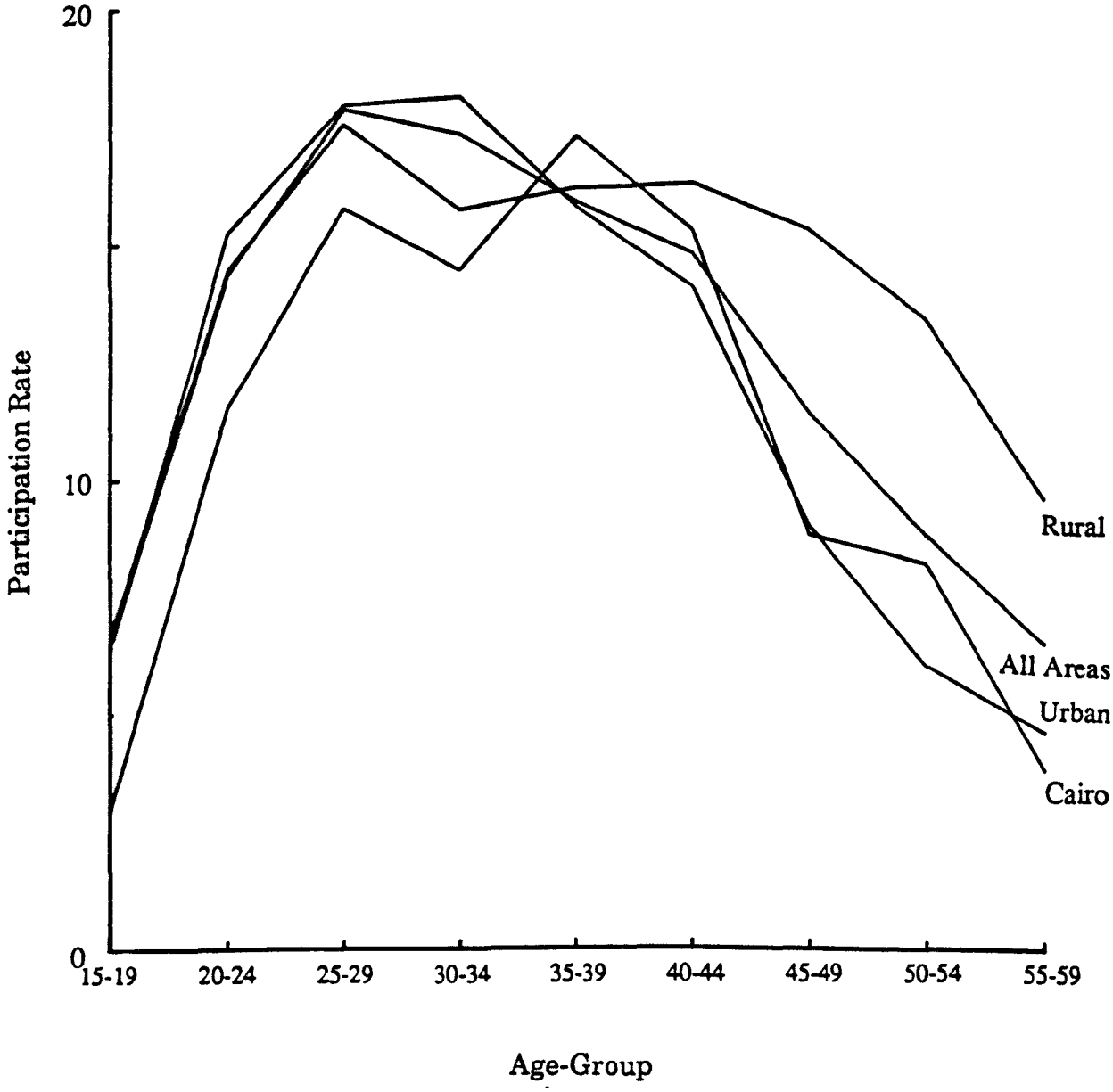
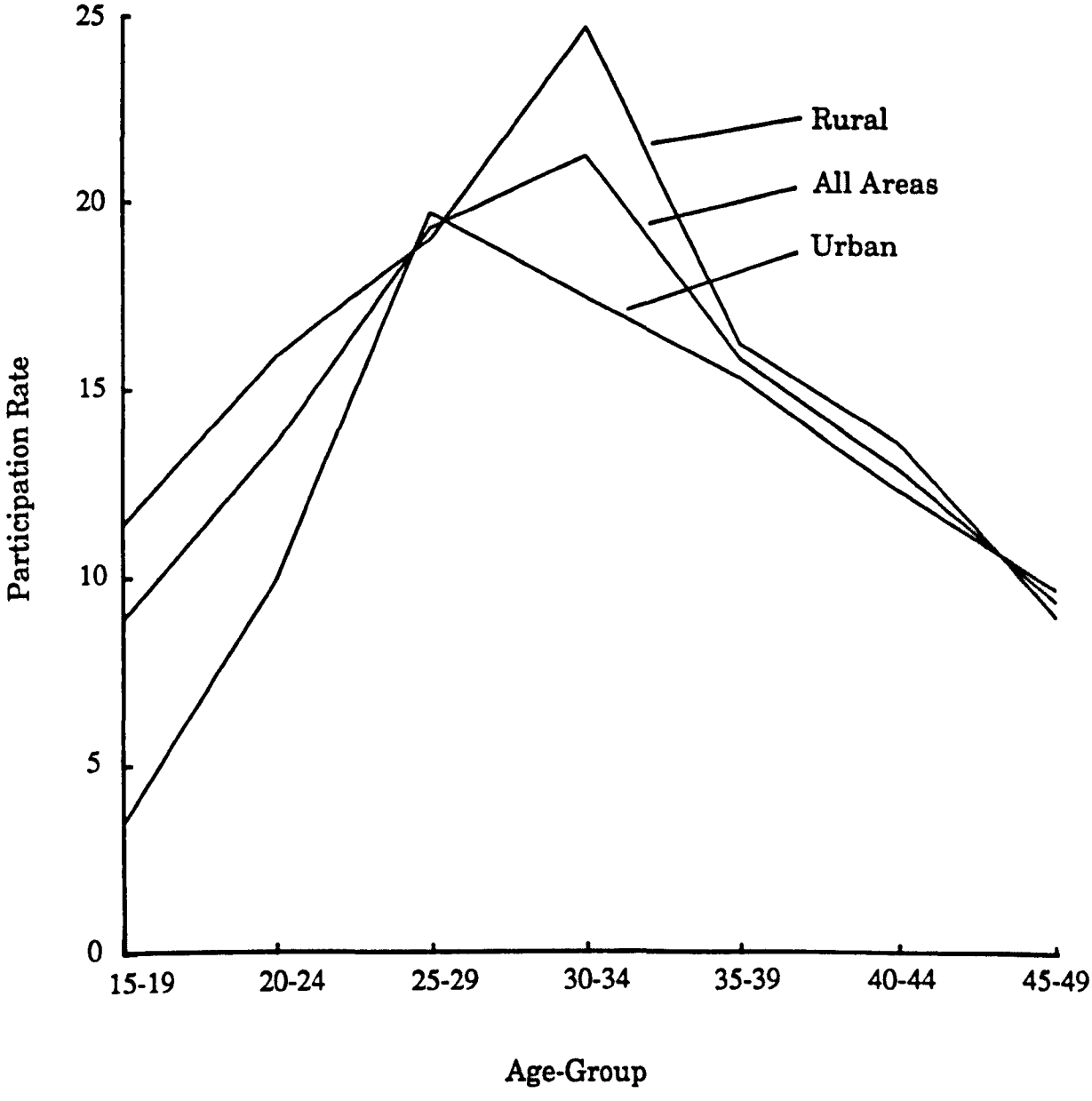


Figure 5.2 Labour Force Participation of Married Females, EFS.



there is a sharp decline in the rate: the peak age-group is later for rural than urban areas. The curves can be characterised as inverted V-shaped curves. The LFS profiles resemble inverted U-shaped curves: participation in the middle of the life-cycle declines gradually after reaching a peak - this is especially the case in rural areas.

Joshi and Owen (1981) have described the age-participation pattern in the UK during this century. Before World War II participation displayed a monotonic decline with age (they use ten year age-groups for females aged 15-64 years). From 1961, there emreges a second peak in activity rates after child-bearing years creating a bi-modal age-participation pattern.

The bi-modal pattern is one observed by married females in Cairo (in the LFS and disregarding the youngest age-group in the EFS) and to a much lesser extent in rural areas (LFS). The return to market participation by married females could partly explain the rising trend in participation by females.

The LFS profiles for single females also resemble inverted U-shaped curves, the peak of the curve being earlier in urban areas and Cairo than in rural areas (see table 5.4a and 5.4b and figure 5.3). For the marital status groups of single females there is no distinctive U-shaped age-participation pattern over all age-groups. The pattern emerges for never-married females in the 15-44 age-group and disregarding the younger age-groups for widowed females. The bi-modal pattern is displayed by married household heads and divorced females (and never-married females although group sizes are too small).

Table 5.4a Age-Participation Profiles of Single Females, 1984

Area / Age-Group	Urban	Rural	Cairo	All Areas
15-19	7.3	15.8	6.5	10.3
20-24	36.4	23.3	38.2	32.7
25-29	44.6	22.2	50.7	36.6
30-34	34.7	21.7	42.3	29.6
35-39	26.2	22.5	30.2	24.7
40-44	23.1	24.6	26.9	23.7
45-49	17.0	24.7	18.9	20.1
50-54	13.2	19.9	16.3	13.7
55-59	10.9	12.4	12.2	11.5
All Ages	22.3	19.5	24.9	21.3

Table 5.4b Age-Participation Profiles of Single Females by Martial Status, Cairo, 1984

Marital Status / Age Group	Never-Married		Married head of household		Divorced		Widowed	
15-19	7.2	(1361)	4.7	(43)	75.0	(4)	-	(0)
20-24	41.0	(1053)	18.3	(142)	33.0	(18)	-	(4)
25-29	62.8	(395)	30.3	(175)	10.0	(20)	30.0	(10)
30-34	60.2	(93)	33.3	(153)	42.9	(21)	29.2	(24)
35-39	61.1	(36)	24.8	(109)	28.6	(21)	20.0	(45)
40-44	37.5	(16)	26.3	(80)	50.0	(26)	18.9	(90)
45-49	66.7	(6)	13.3	(45)	22.2	(18)	17.5	(114)
50-54	8.3	(12)	22.2	(36)	40.0	(15)	11.7	(192)
55-59	50.0	(4)	15.8	(19)	25.0	(8)	9.7	(153)
All Ages	29.2	(2976)	24.6	(802)	33.8	(151)	14.7	(632)

Figures in brackets are size of sub-group.

Figure 5.3 Age-Participation Profiles of Single Females, LFS.

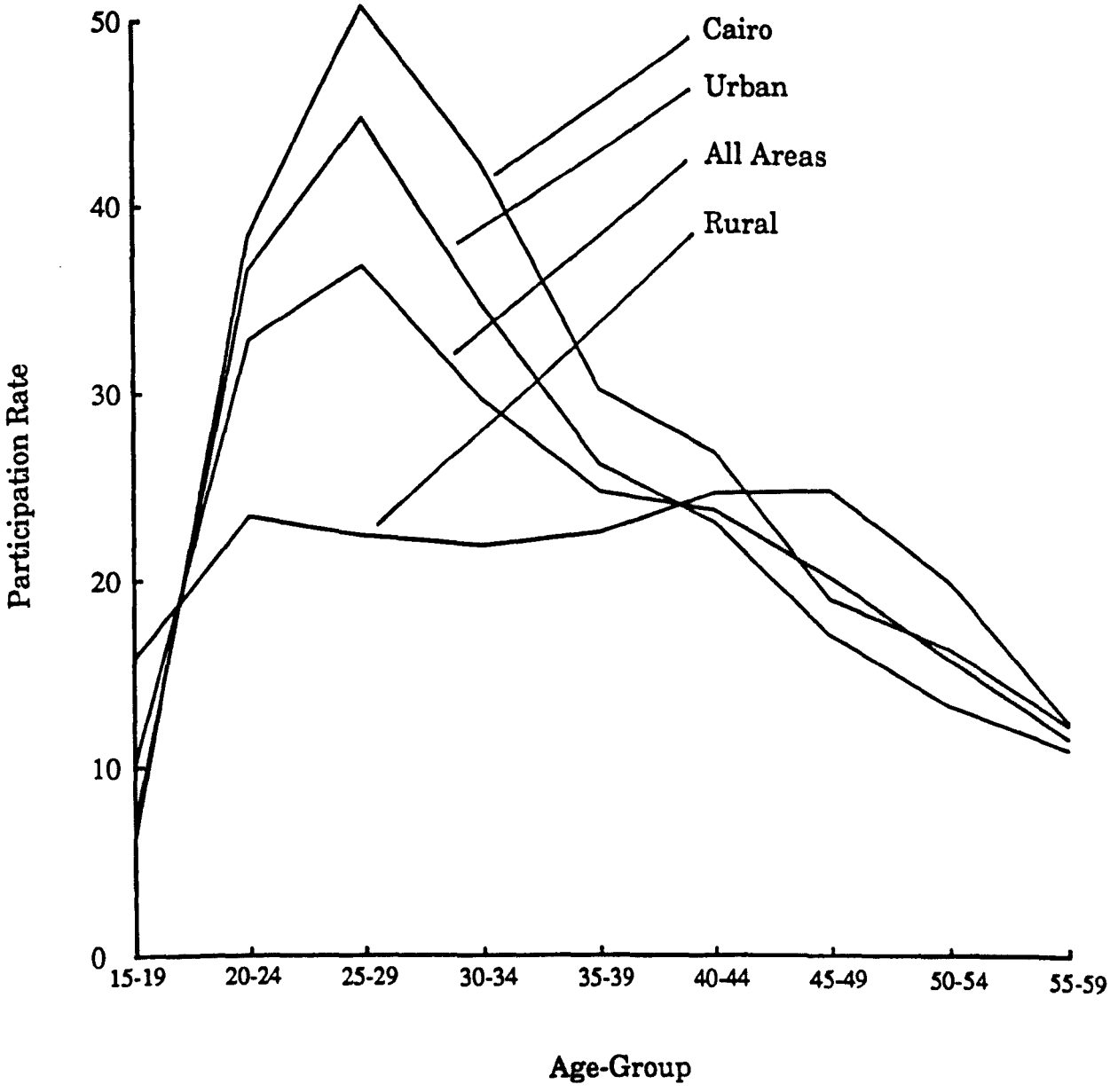


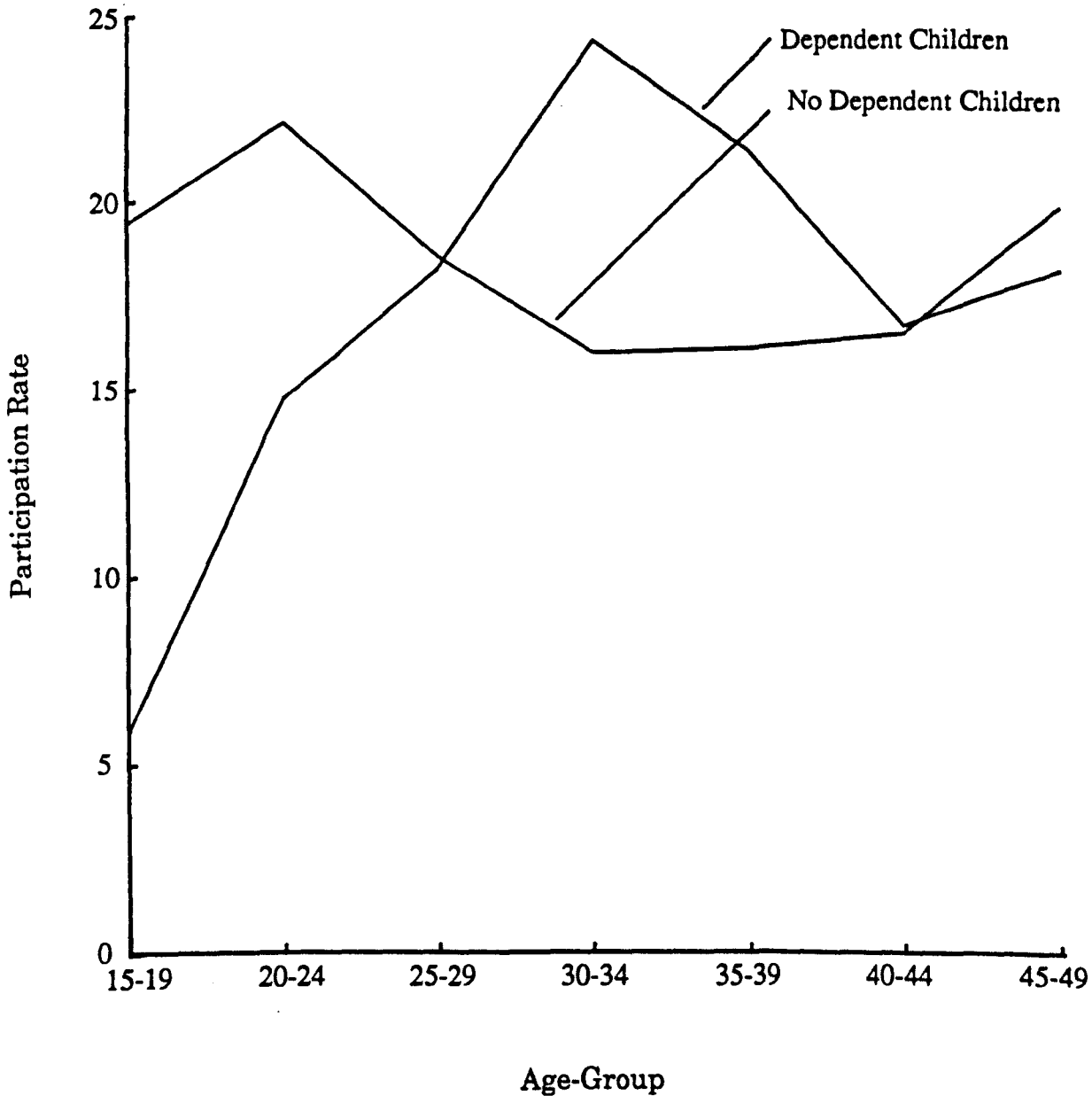
Table 5.5 Age-participation Rates of Married Females by Presence of Dependent Children[a], 1980

Area	All Areas		Urban Areas		Rural Areas	
Age Group	1	2	1	2	1	2
15-19	5.9 (102)	19.4 (103)	3.6 (28)	7.4 (27)	6.8 (74)	23.7 (76)
20-24	14.7 (408)	22.1 (86)	5.6 (126)	33.3 (30)	18.8 (282)	16.1 (56)
25-29	18.1 (398)	18.5 (54)	17.1 (170)	25.0 (28)	18.9 (228)	11.5 (26)
30-34	24.4 (406)	16.0 (81)	22.2 (167)	20.0 (45)	25.9 (239)	11.1 (36)
35-39	21.4 (257)	16.1 (137)	21.9 (114)	15.3 (72)	21.0 (143)	16.9 (65)
40-44	16.7 (102)	16.5 (200)	17.9 (28)	13.9 (108)	16.2 (74)	19.6 (92)
45-49	18.2 (33)	19.9 (186)	- (11)	16.7 (90)	27.3 (22)	22.9 (96)
All Ages	18.5(1706)	18.2 (847)	16.1(644)	17.3 (400)	19.9(1062)	19.0(447)

Figures in brackets are size of sub-group

(a) Children aged less than 5 years
1 Dependent children present
2 No dependent children present

Figure 5.4 Age-Participation Profiles of Married Females, All Areas.



The presence of young children is considered to affect the life-cycle pattern of participation of married females. Table (5.5) presents the participation profiles by presence of dependent children. Participation rates for mothers are distinctively lower only for young mothers, the rates being higher in the older age groups for females with young children. An explanation for this could be that those who bear children later in the life-cycle are more career-minded and would tend to continue market participation even with the presence of young children. Another explanation could be that responsibility for young children is shared by older children.

5.2 Definition of Variables and Estimation Procedure

In this study an empirical procedure based on and adapted from the approach presented in Chapter III is utilised. The purpose of this estimation procedure is to examine a number of hypotheses within a unified empirical framework. The first step in the procedure is to obtain probit coefficient estimates for the reduced-form probability of participation function. As mentioned in Chapter III, statistical methods such as ordinary least squares are inappropriate for estimating relationships with a qualitative dependent variable. In application the transformation of p has a value of 5 added to the probit, so that the transformed variable is uniformly positive (spss-x package):

$$T(p) = \text{probit}\ (\bar{y}^{T}\ \bar{Z}/\sigma) + 5 \qquad (5.1)$$

A second characteristic of this procedure is the use of grouped data. The SSPS-X package cannot handle data which is given in case-by-case form or which has only one observation per cell where the definition of a cell is one combination of the predetermined explanatory variables). This required the transformation of the explanatory variables so that the number of cells are reduced and at the same time ensuring that each cell contains many observations. This has meant, that, because there are up to six explanatory variables in an equation, each explanatory variable had to be redefined into as small a number of divisions as possible. Maximum likelihood estimates are obtained by relating the response probabilities to the explanatory variables, and solving the system

of equations from the likelihood function by numerical methods.

Least squares regression is used to estimate the coefficients of the market wage function. Inclusion of the selectivity bias index in the market wage equations, which were calculated from the probit coefficient estimates, is used to test for the existence of selection bias in the estimated function.

Coefficients for the shadow price of time are then calculated from the coefficient estimates of the reduced form participation function and the market wage function (the method of calculation is presented in the next section).

The hours function for all females and that for workers is then estimated using least squares regression. Selection bias in the coefficient estimates for the sub-group of workers is tested by the inclusion of the selectivity bias index in the functions.

Finally, the proportionality hypothesis proposed by Heckman is examined. The hypothesis proposed is that the hours worked are proportional to the gap between the offered wage and asking wage. A female with a greater probability of working is also more likely to work longer hours.

The above procedure is applied to the following sub-groups:

(1) Married females aged 25-49.

(2) Single females aged 25-59 and to each marital sub-group of single females

(3) All households

(4) Households reporting cash income

The set of explanatory variables used to explain the labour supply of females are: (1) weekly earnings; (2) weekly earnings other than female earnings; (3) the presence of an unemployed family member; (4) age-group; (5) level of schooling; (6) number and age composition of children; (7) family size; (8) family status.

(1) Weekly Earnings (W, IW)

The measure of the wage variable, gross weekly earnings, is used in the hours function of workers and the hours function of all females. An imputed wage is also used. The use of an offered wage function is a means of dealing with two problems:

(i) to obtain a measure of the permanent wage and;

(ii) to obtain a value for the expected earnings of non-workers.

The semi-logarithmic specification of the earnings function is adopted:(1)

$$\ln W = \alpha_0 + \alpha_1 ED + \alpha_2 AGE \qquad (5.2)$$

Where:

IW : imputed wage

W : earnings of worker

ED : schooling level attained

AGE : age-group

and IW = ln W

The expected growth of earnings with age is a reflection of the

self-investment activities (such as on-the-job training) that are continued after completion of schooling. Thus, in the case of females where attachment to the labour force is not continuous, information on years of experience is necessary. However, this is not available in the LFS. Age is thus taken as a measure for experience. Correction for selectivity bias (discussed in Chapter III) is also applied.

$$\ln W = \alpha_0 + \alpha_1 ED + \alpha_2 AGE + \alpha_3 T \quad (5.3)$$

Where $T = f(-\bar{y}^T \bar{Z}/\sigma)/1-F(-\bar{y}^T \bar{Z}/\sigma)$

F and f are distribution and density functions of the standard normal random variable family weekly earnings.

(2) Income (INCGRP)

From the variable gross weekly earnings of other family members, two income variables were constructed:

(i) All households reporting household cash income are divided into two groups, taking the median of the income distribution as the point of division and using a categorical variable as the representation of income.

(ii) A categorical variable, for all households is used to represent those reporting cash income and those reporting no cash income.

(3) Unemployment (UN)

A dummy variable for the presence of an unemployed family member is used for the measure of the unemployment variable. It is more difficult on the individual level to assess whether the added-worker or discouraged-worker effect dominates. However, it might be possible to assume that married females are more sensitive to employment opportunities than single females.

(4) Age (AGEGRP)

The age of the female reflects different life-time work patterns of different cohorts. This makes it difficult to isolate a pure age effect. However, it is expected that a purely age effect has a negative effect on participation which might also be compounded by a cohort effect. Age is entered as a categorical variable representing age level; the groups being the (25-34) and the (35-49) age groups.

(5) Schooling (ED)

A variable representing the level of schooling: primary level and below, and, greater than primary level is used as a measure of the education variable. A higher level of schooling represents greater employability and greater earnings.

(6) Fertility Variables (DCH, NCH, AYCH, FMZ)

The hypothesis that for married females pre-school children have the greatest impact on the mother's labour supply (because they

demand a greater amount of the mother's time) is tested using the following measures for the fertility variable:

(i) dummy variables for the presence of children aged less than 3 years (DCH1), aged between 3-5 years (DCH2) and aged 6-11 years (DCH3);

(ii) numbers of children in the age-groups aged less than 3 years NCH1, aged between 3-5 years (NCH2) and aged 6-11 years (NCH3) and;

(iii) age of youngest child, (AYCH).

The number of children places pressure on the mother's time as well as the pressure for greater income. It is expected for younger-age children that the demand for the mother's time would outweigh the need for additional income, while for older-agechildren, the need for income might be greater than the need for the mother's time.

For single females family size is taken as the fertility variable. The demand for female time and for income might be similar to those of married females, but using this variable it is more difficult to assess its impact on participation.

(7) Family Status (HEAD, SING)

The family status of a single female might be expected to influence her labour force status. The pressure to work for a secondary member of the household might be less than that for a head of household. A dummy variable representing the status as household head is used. In the sub-group of single females, never-married

females have the highest participation rate. A dummy variable representing never-married status is used: the effect on hours worked is also expected to be positive. The inclusion of this variable is to examine the relative importance of being never-married in comparison to other variables.

5.3 Results for Married Females

The results for married females are presented in tables (5.6) to (5.10). Probit estimates for the coefficients of the participation function are presented in table (5.6). The chi-squared goodness of fit statistic (X^2) shows that for four sets of results (1.1, 1.2, 3.1, 3.2) the explanatory variables are a significant determinant of the probability of labour force participation.

The results for the offered wage function presented in table (5.7) show that the two variables, schooling and age explain only 10% of the variation in earnings between workers. However, this is to be expected. Age may not be a good measure for market experience. And, as demonstrated by Mincer the earnings-schooling relationship on the individual level is weak (but when averaged over groups of individuals, the relationship is stronger). The coefficients of the selectivity bias (T) index are not statistically significant (although marginal) and the wage coefficient estimates are essentially unchanged when T is included. These results indicate that in this data set selection bias in the offered wage function is not a problem.

Table (5.8) shows that the set of explanatory variables explain between fourty and fifty percent of the variation in the all hours

function. The set of explanatory variables explain only ten percent of the variation in the hours of workers. Again, the effect of selectivity bias is found to be insignificant. The proportionality hypothesis proposed by Heckman is examined using coefficients from the hours of workers and the probability of participation functions. The ratio of these coefficients, presented in table (A5.1), support this hypothesis. Expect for one case, the coefficients are positive in sign.

There is also close agreement in the magnitude of the ratio of coefficients, especially for those probit and hours coefficients which are statistically significant.

Now follows the examination of results obtained for each variable. The results indicate that the level of schooling has a highly significant effect on the praticipation decision. Coefficients of this variable are significant at the 1% level in all functions. The effect of this variable is, as expected, positive. An increase in the level of schooling increases the shadow price of time of a female by fifteen to fourty percent, which leads to an increase in the probability of participation of between fourty-seven and fourty-eight percent. The effect on hours is strongly positive and a female with a higher level of schooling has an average work week that is between 6.2 and 6.9 hours longer. In the hours function for all females the magnitude of the variable is the greatest.

The employment status of other family members is also an important factor in the participation decision. Market uncertainty related to the unemployment of a household member causes an increase

Table 5.6 Probit Analysis: Labour Force Participation of Married Females, 25-49

Explanatory Variables	1.1[a] PC	1.1[a] PE	1.2[b] PC	1.2[b] PE	2.1[a] PC	2.1[a] PE	2.2[b] PC	2.2[b] PE	3.1[a] PC	3.1[a] PE	3.2[b] PC	3.2[b] PE
ED	1.96 (27)***	.48	1.9 (23)***	.47	1.95 (27)***	.48	1.9 (23)***	.47	2 (24)***	.48	1.9 (21)***	.47
UN	-.4 (2.2)***	-.16	-.3 (-1.5)	-.12	-.4 (-2.3)***	-.16	-.3 (-1.5)***	-.12	-.12 (-.6)	-.05	-.04 (-.2)***	-.02
AGEGRP	-.05 (-.6)	-.02	-.14 (-1.6)	-.06	-.05 (-.6)	-.02	-.15 (-1.6)	-.06	-.03 (-3)	-.02	-.1 (-.8)	-.04
INCGRP	.7 (5.7)***	.26	.5 (5.7)***	.19	.68 (5.6)***	.25	.5 (5.7)***	.19	.7 (4.7)***	.26	.5 (5.4)***	.19
DCH1	-.14 (-1.7)*	-.06	-.2 (5.7)**	-.08								
DCH2	.03 (.4)	.01	.09 (1.1)	.04								
DCH3	-.02 (-.3)	-.01	-.05 (-.6)	-.02								
NCH1					-.1 (-.65)*	-.04	-.12 (-1.8)*	-.05				
NCH2					.03 (.4)	.01	.07 (1.1)	.03				
NCH3					-.04 (-.9)	-.02	-.06 (-1.3)	-.03				
AYCH									.02 (1.5)	.01	.014 (1.03)	.008
Intercept	.22 (.7)		1.08 (4.9)***		.25 (.8)		1.1 (5)***		-.009 (-.03)	.8 (3.9)		
χ^2	94		65		376		326		97		96	
df	85		82		262		240		121		125	
p	.24		.91		0		0		.94		.98	

***, **, * significant at the 1%, 5%, 10% level.

PC : Probit Coefficient
PE : Participation Effect
[a] households reporting cash income
[b] all households
[c] calculated from the inverse to the probit transformation, i.e., the standard normal cumulative distribution

Table 5.7 Offered Wage Function for Married Females, 25-49 with Test for Selectivity Bias

Explanatory Variable	1.1	1.1	2.1	2.1	3.1	3.1
ED	.44	.44	.44	.44	.42	.42
	(4.9)***	(4.9)***	(4.9)***	(4.9)***	(4.9)***	(4.9)***
AGEGRP	.34	.34	.34	.34	.24	.25
	(4.9)***	(4.9)***	(4.9)***	(4.9)***	(3)***	(3.2)***
T		-.01		-.01		-.001
		(-1.5)		(-1.5)		(-1.5)
Intercept	6.2	6.2	6.2	6.2	6.4	6.4
	(32)***	(32)***	(32)***	(32)***	(33)***	(33)***
R^2	.11***	.11***	.11***	.11***	.10***	.10***

***, **, * significant at the 1%, 5% and 10% level respectively.

Table 5.8 Asking Wage Function for Married Females, 25-49(1)

Explanatory Variables	1.1	2.1	3.1
ED	.152	.33	.43
UN	.059	.023	9.96×10^{-3}
INCGRP	-.103	-.039	-.058
DCH1	.021		
DCH2	-4.4×10^{-3}		
DCH3	2.9×10^{-3}		
NCH1		5.8×10^{-3}	
NCH2		-1.74×10^{-3}	
NCH3		2.32×10^{-3}	
AYCH			-1.66×10^{-3}

(1) obs: $(\bar{\alpha}^T \bar{x} - \bar{\beta}^T \bar{y}) = (\bar{\gamma}\ \bar{z})$

To estimate $\bar{\beta}$:

(a) If the variable is only in the probability of participation function then $\hat{b}_i = -\delta\ \hat{\gamma}_i$

(b) If the variable is in both equations then:
$\hat{b}_i = \hat{\alpha}_i - \delta\ \hat{\gamma}_i$

Table 5.9 Hours Function of All Married Females, 25-49

Explanatory Variables	1.1	1.2	2.1	2.2	3.1	3.2
ED	21 (34)***	20 (39)***	-	-	22 (37)***	22 (31)***
UN	-1.3 (-2.5)**	-1.3 (-1.8)*	-1.3 (-1.8)*	-1.3 (-1.5)*	-.2 (-2)	-.3 (-.2)
AGEGRP	-1.3 (-2.5)**	-.8 (-1.8)	-.8 (-1.8)*	-1.3 (-2.5)**	-.5 (-1)	-1 (-1.6)
INCGRP	2.8 (5.8)***	2.2 (4.8)***	2.2 (4.7)***	2.8 (5.8)***	1.9 (3.7)***	3.1 (5.6)***
DCH1	-1 (-2)**	-.8 (-1.9*				
DCH2	.6 (1.3)	.3 (.6)				
DCH3	-.4 (-.9)	-.15 (-.4)				
NCH1			-.5 (-1.8)*	-.7 (-2)**		
NCH2			.2 (.7)	.5 (1.3)		
NCH3			-.1 (-.5)	-.2 (-.9)		
AYCH					.1 (1.6)	.01 (1.1)
W	.002 (16)***	.002 (18)***	.002 (17.9)***	.002 (16)***	.002 (14)***	.001 (12)***
Intercept	-21 (-16)***	-21 (-16)***	-21 (-17)***	-21 (-16)***	-24 (-18)***	-23 (-20)***
R^2	.49***	.46***	.46***	.49***	.46***	.48***

***, **, * significant at the 1%, 5% and 10% level respectively.

Table 5.10 Hours Function for Working Married Females, 25-49 with Test for Selectivity Bias

Variables	1.1	1.1	2.1	2.1	3.1	3.1
ED	6.6 (4.4)***	6.6 (4.5)***	6.8 (4.5)***	6.9 (4.6)***	6.2 (3.6)***	6.2 (3.6)***
AGEGRP	-2.7 (-1.9)*	-2.7 (-1.9)*	-2.1 (-1.5)	-2 (-1.5)	-2.4 (-1.3)	-2.3 (-1.3)
INCGRP	2.4 (1.7)*	2.4 (1.7)*	2.3 (1.6)	2.4 (1.67)*	2.7 (1.6)	2.7 (1.6)
DCH1	-2.1 (-1.5)	.2 (-1.5)				
DCH2	-.4 (-.3)	-.4 (-.4)				
DCH3	-2 (-1.7)*	-2 (-1.7)*				
NCH1			-1.1 (-1.1)	-1 (-1)		
NCH2			-.02 (-.02)	-.02 (-.02)		
NCH3			-.2 (-.3)	-.2 (-.3)		
AYCH					.24 (1)	.25 (1)
W	.0003 (2.6)***	.0003 (2.6)***	.0003 (2.6)***	.0003 (2.6)***	.0003 (2.1)**	.0003 (2)**
T		-.1 (-1.1)		-.12 (-1.1)		-.04 (-.3)
Intercept	26 (6.8)***	26 (6.7)***	23 (6)***	24 (6)***	23 (5.8)***	23 (5.7)***
R^2	.11**	.11*	.10*	.10*	.09*	.09*

***, **, * significant at the 1%, 5% and 10% level respectively.

in the shadow price of time of between two and twelve percent leading to a decrease in the probability of participation of two to sixteen percent. The effect of this variable is also negative and statistically significant in the all hours function. These findings represent strong evidence of the discouraged worker effect among married females in Cairo.

The variable for age was not found to be statistically significant in the probit function, although some of the t-values are just marginal. The expected negative effect lowers the probability of participation by two to six percent. The coefficients in the all hours functions are statistically significant in nearly all the estimated equations. The magnitude of the coefficients are large in some equations and as expected, the effect of this variable is negative. A female belonging to the older age group is expected to have a reduction in the average work week of nearly three hours.

The effect of the level of household income is statistically significant in all probit functions. The effect of income on the participation decision is positive. The positive effect of this variable is contrary to theoretical expectation, so it might be fair to say that this variable is an inadequate measure of income. However, acquisition of earnings at low levels of income might increase the desire for greater earnings. A higher level of income lowers the shadow price of time by nearly ten percent increasing the probability of participation by nearly twenty-five percent. The effect of this variable is positive and statistically significant in the all-hours function and in some of the equations for workers.

The pressure of children exerts an effect on the participation decision of mothers only for young preschool children. The variables DCH1, NCH1 are statistically significant in the probit function at the 10% level. The presence of a child under three years of age raises the shadow price of time of the mother by two percent leading to a reduction in the probability of participation of six to eight percent. The effect of an additional child under three years of age reduces the shadow price of time by less than one percent, increasing the probability of participation by a further one percent.

The variable for the age of the youngest child has a t-value that is marginal and shows that as the age of the youngest child increases the mother's probability of participation also increases. The difference in the probability of participation of a mother who has a youngest child aged one year and one who has a youngest child aged ten years is 9% (the increase is 1% for each additional year).

The all-hours function shows that the t-value for DCH1, NCH1 are significant at the 5% level. The coefficient for AYCH is found to be negative, when statistically significant. This is contrary to expectation. The hours for workers have statistically significant t-values for DCH3. The presence of a child aged 6-11 years reduces the working week of the mother by two hours and each additional child in that age-group causes a further reduction of .2 of an hour. An explanation could be that school-age children require some attention from the working mother. The coefficients for DCH1 are not statistically significant, but the t-values are marginal.

Overall, the results suggest that pre-school children have the

greatest effect on participation while older children, aged 6-11 years, exerts the greatest effect on working mothers.

The effect of wages on the hours of all females is statistically significant in nearly all regressions. An increase in the weekly wage rate of E£10 increases the work week by nearly 2 hours. However, in terms of elasticity measure(2) (coefficient taken from table 5.10) a value of .02 indicates strong inelasticity of hours with wages.

5.4 Results for Single Females

The empirical results for single females are presented in tables (5.11) to (5.16). Probit estimates for the coefficients of the participation functions are presented in tables (5.11) and (5.12). It is difficult to assess the statistical performance of the participation model. The chi-squared goodness of fit statistics indicate that the functions in table (5.10) give a better fit to the model than those in table (5.11). A better fit to the model is also obtained for the individual status sub-groups rather than the sub-group of all single females. This might be expected since single females as a group are a heterogeneous group and their behaviuor is relatively more difficult to predict.

The results for the offered wage function, presented in table (5.13), show that the two variables age and education explain up to twenty-five percent of the variation in wages. These results can be considered good. Selection bias does not cause a problem in estimation as shown by the t-value for the T-index.

Table (5.15) shows that the set of explanatory varaiables explain up to sixty-three percent of the variation in the hours of all females. The use of the actual wage rather than imputed wage increases the explanatory power of the model. (The results using the imputed wage are presented in Appendix III). For the hours of workers, the set of explanatory variables explain up to seventeen percent of the variation in the average work week. The problem of selection bias is not significant (as indicated by the t-value for the T index).

Finally, the coefficient ratios in table (A5.2) are mainly positive, and all positive in sign when both coefficients are statistically significant. This supports the proportionality hypothesis.

Table 5.11 Probit Analysis: Labour Force Participation of Single Females, 25-59(1)

Explanatory Variable	1.1 PC	1.1 PE	2.1 PC	2.1 PE	3.1 PC	3.1 PE	4.1 PC	4.1 PE	5.1 PC	5.1 PE
ED	1.6 (16)***	.445	2.8 (5)***	.497	2 (-12)***	.477	5.6 (2.1)***	.499	1 (4.1)***	.341
UN	-.2 (-1.6)	-.079	-2.2 (-2.1)**	-.486	-.2 (-.9)	-.079	1.1 (1.6)	.36	-.4 (-1.6)	-.155
AGEGRP	-.4 (-3.3)***	-.155	.4 (.8)	.155	.07 (.2)	.028	-.1 (-.2)	-.040	-1 (-3.6)***	-.341
INCGRP	.2 (2.34)***	.079	.13 (.3)	.052	.2 (.2)	.079	.71 (1.5)	.261	.3 (1.6)	.118
FMZ	-.12 (-5)***	-.048	-.01 (-.1)	-.004	-.11 (-2.6)***	-.044	-.5 (-3.4)***	-.192	-.1 (-1.9)*	-.040
HEAD	.44 (3.8)***	.17			3.7 (.8)	.49	-.3 (-.5)	-.118	.3 (1.5)	.118
SING	.4 (3.1)***	.155								
Intercept	3.3 (11)***		-65 (.37)		2.5 (4.4)***		.3 (.1)		4.9 (7.2)***	
x2	277		37		88		36		80	
df	272		32		80		41		80	
p	0		.25		.26		.69		.48	

***, **, * significant at the 1%, 5% and 10% levels respectively

PC Probit Coefficient
PE Participation Effect

Note:

(1) Households reporting cash income
1.1 All Single
2.1 Married household head
3.1 Never-married
4.1 Divorced
5.1 Widowed

Table 5.12 Probit Analysis: Labour Force Participation of Single Females, 25-59(1)

Explanatory Variables	1.2 PC	1.2 PE	2.2 PC	2.2 PE	3.2 PC	3.2 PE	4.2 PC	4.2 PE	5.2 PC	5.2 PE
ED	1.5 (18)***	.43	1.6 (5.8)***	.45	1.9 (-13)***	.47	2.1 (4)***	.48	1.1 (5.3)***	.36
UN	-.1 (-.8)	-.04	-1.5 (-2)**	-.43	-.01 (-.1)	-.004	.3 (.6)	.12	-.3 (-1.6)	-.12
AGEGRP	-.3 (-2.7)***	-.12	-.08 (-.3)	.032	-.2 (-.7)	.079	-.2 (-.7)	-.079	-.7 (-3.4)***	-.26
INCGRP	1.4 (13)***	.419	2 (7.7)***	.477	1.4 (7.8)***	.419	1.7 (4.4)***	.455	1.3 (6.7)***	.403
FMZ	-.1 (-4.5)***	-.039	-.002 (-.02)	-.008	-.12 (-3.5)***	-.048	-.2 (-2.9)***	-.079	-.02 (-.7)	-.008
HEAD	.18 (1.7)***	.071			.51 (1.3)	.195	.4 (1.5)	.155	.21 (1.2)	.083
SING	.4 (4.3)***	.155								
Intercept	.7 (2.4)**		-1.1 (-1.2)		.6 (1.1)		.34 (.3)		1.8 (3.2)***	
X2	615		251		102		62		189	
df	270		54		89		60		108	
P	0		0		.16		.41		0	

***, **, * significant at the 1%, 5% and 10% levels respectively

PC Probit Coefficient
PE Participation Effect

(1) All Households
1.2 All Single
2.2 Married household head
3.2 Never-married
4.2 Divorced
5.2 Widowed

Table 5.13 Offered Wage Function for all Single Females and by Marital Status 25-59, with Test for Selectivity Bias

Explanatory Variables	1.1	1.1	2.1	2.1	3.1	3.1	4.1	4.1	5.1	5.1
ED	.5 (5.7)***	.5 (3.7)***	1.3 (4.7)***	1.3 (4.6)***	.24 (2.6)***	.2 (2.5)***	.6 (3)***	.5 (2.7)***	.65 (1.9)*	.7
AGEGRP	.29 (3.7)***	.29 (3.7)***	.5 (3)***	.5 (3)***	.13 (1)	.13 (1)	.4 (1.98)*	.4 (1.9)*	.1 (.3)	.2 (.5)
T		-.002 (-.3)		.005 (.35)		.006 (1.4)		-.01 (-.6)		.04 (.8)
Intercept	6.1 (30)***	6.1 (30)***	4.4 (6.7)***	4.4 (6.6)***	6.7 (26)***	6.7 (26)***	6 (13)***	6 (13)***	6 (7)***	6 (7)***
R^2	.06	.06	.25**	.24**	.02	.03	.21**	.20**	.06	.06

***,**,* significant at the 1%, 5% and 10% level

Table 5.14 Shadow Price of Time for all Single Females and by Marital Status, 25-59(1)

Explanatory Variables	1.1	2.1	3.1	4.1	5.1
ED	-1.7	-.94	-.84	-.8	-9.35
UN	.276	1.76	.108	-.272	4.0
IN	-.276	-.104	-.108	-.178	-3.0
FMZ	.166	$8x10^{-3}$	.059	.125	1.0
HEAD	-.607		-(19.98)	.075	-3.0
SING	-.55				

(1) obs: $(\bar{\alpha}^T \bar{x} - \bar{\beta}^T \bar{y}) = (\bar{\gamma}\ \bar{z})$

To estimate $\bar{\beta}$:

(a) If the variable is only the probability of participation function then $\hat{b}_i = -\sigma\ \hat{y}_i$

(b) If the variable is in both equations then:
$\hat{b}_i = \hat{\alpha}_i - \sigma\ \hat{\alpha}_i$

Table 5.15 Hours Function of All Single Females, 25-59

Explanatory Variables	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
ED	17.7 (21)***	20.8 (19)***	17.6 (13)***	22.0 (10)***	12.9 (8.9)***	16 (9.5)***	12.6 (3.3)***	11.2 (2.2)***	14.8 (7.7)***	17.0 (6.2)***
UN	-4.7 (-5)***	-4.7 (-3.8)***	-2.9 (-1.98)**	-4 (-1.6)	-4.5 (-3)***	-3.8 (-2.4)***	1.2 (.3)	6.1 (1.1)	-1.4 (-1)	-3.1 (-1.3)
AGEGRP	-2.5 (-3)***	-4.9 (-3.8)***	-2.8 (-2.5)**	-6.8 (-2.8)***	-2.9 (-1.2)	-1.7 (-.6)	-3.3 (-1.4)	-6 (-1.7)*	-3.6 (-2.3)**	-8.3 (-2.7)***
INCGRP	9.8 (13.1)***	1.9 (1.96)**	10.3 (10)***	1.4 (.7)	10.8 (6.3)***	-1 (-.6)	3.7 (1.5)	-.4 (-.1)	6.1 (5.7)***	1.63 (.9)
FMZ	-.1 (-1.4)	-.3 (-1.65)*	-.1 (-.6)	-.6 (-1.1)	-.2 (-.5)	.2 (.5)	-.5 (-1)	-1 (-1.4)	-.05 (-.4)	-.13 (-.6)
HEAD	4.2 (4.9)***	6.6 (5)***			8.2 (2.4)***	15 (3.3)***	3.4 (1.4)	2.5 (.7)	3.8 (3.0)***	5.9 (3)***
SING	5.2 (5.5)***	5.4 (4.5)***								
W	.002 (12.6)***	.002 (10)***	.001 (7.5)***	.001 (5.5)***	.01 (13)***	.01 (12)***	.01 (6.4)***	.01 (5.3)***	.001 (7.3)***	.001 (5.7)***
Intercept	-26 (-12)***	-10 (-3.5)***	-23 (-8)***	-.5 (-.1)	-20 (-4.2)***	-6 (-1.1)	-9 (-1.3)	6.8 (.6)	-17 (-4)***	-.9 (-.1)
R^2	.45**	.45**	.38**	.41**	.55**	.51**	.61**	.63**	.22**	.22**

***, **, * significant at the 1%, 5% and 10% level

Table 5.16 Hours function for Working Single Females, 25-59

with Test for Selectivity Bias

Explanatory Variables	1.1	1.1	2.1	2.1	3.1	3.1	4.1	4.1	5.1	5.1
ED	5.4 (3.9)***	5.4 (3.9)***	7.0 (2.6)***	7.0 (2.6)***	.1 (.1)	-.1 (-.1)	9 (1.4)	9.6 (1.5)	10.9 (2.0)***	10.9 (1.9)*
AGEGRP	-3.2 (-2)***	-3.2 (-2)***	3.5 (1.2)	3.7 (1.3)	-3.7 (-1.4)	-3.7 (-1.3)	-6.5 (-1.0)	-5.3 (-.8)	-1.2 (-.2)	-1.1 (-.2)
INCGRP	1.6 (1.4)	1.5 (1.3)	-2.3 (-.8)	-2.4 (-.9)	.14 (.1)	.2 (.1)	-3.7 (-.6)	-2.9 (-.5)	2.6 (.5)	2.6 (.5)
FMZ	.5 (1.64)	.5 (1.6)	.84 (1.1)	.84 (1.1)	.3 (.9)	.3 (.9)	.8 (.5)	.7 (.4)	.5 (.4)	.5 (.3)
HEAD	7.2 (4.5)***	7.2 (4.5)***			5.1 (1.65)***	4.9 (1.6)	6.8 (1.1)	5.9 (.9)	14. (2.6)**	14.2 (2.5)**
SING	3.6 (2.7)***	3.7 (2.7)***								
W	.0004 (2.6)***	.0004 (2.6)***	.0003 (1.5)	.0003 (1.5)	.002 (3.3)***	.002 (3.3)***	.005 (1.8)***	.005 (1.7)*	.0002 (.7)	.0002 (.9)
T		-.1 (-.6)		.2 (.8)		-.1 (-1.3)		-.3 (-1.1)		-.2 (-.3)
Intercept	23 (5.6)***	22 (5.1)***	21 (2.5)***	21 (2.6)***	39 (7.6)***	39 (7.7)***	20 (1.3)	17.0 (1.0)	3.6 (.2)	3.6 (.2)
R^2	.09*	.09*	.03	.03	.03	.03	.17**	.17*	.11*	.10*

***, **, * significant at the 1%, 5% and 10% level

The remaining part of the section is an analysis of the effect of each explanatory variable on the labour supply of single females.

The effect of education is as expected positive and statistically significant in all functions. The attainment of at least a secondary level certificate reduces the shadow price of time of all the individual martial status group (the value for widowed females is questionable). This leads to an increase in the probability of participation of between fourty-five and fifty percent for never-married, married heads of households and divorced females; and about thirty-five percent for widowed females. For the all-hours function, never-married females display the greatest responsiveness to the level of schooling. For the hours of workers, the coefficient estimates are statistically significant only for married head of households and widowed females. The results indicate an increase in the average work week of about five hours for a single female with a higher level of education.

The effect of unemployment on the probability of participation is statistically significant for married household heads. The presence of an unemployed household member increases the shadow price of time leading to a reduction in the probability of participation of fourty-eight percent. The coefficients in the all hours function are statistically significant for the sub-groups of all single females, married household heads and never-married females. The sign of the coefficient estimates are negative indicating that a discouraged-worker effect is also prevalent amongst single females.

The size of the family has a depressing effect on the probability of participation of single females. An increase in family size of one individual increases the shadow price of time by up to sixteen percent, decreasing the probability of participation by as much as twenty percent (for divorced females). The negative effect of the size of family is also reflected in the coefficient estimates of the all hours functions, being greatest in magnitude for the sub-group of divorced females. The effect on the hours of workers is not significant.

The status of being single reduces the shadow price of time by over fifty percent leading to an increase in the probability of participation of 16%. The positive sign in the all hours function confirms the effect, which is translated into a reduction of four hours in the average work week.

The coefficient estimates for the level of income is, as for married females, positive in sign. An increase in the level of income lowers the shadow price of time by up to twenty eight percent, increasing the probability of participation by eight percent. The positive effect of the income level is again reflected in the coefficient estimates for the all-hours function and translated into a one and a half hour rise in the average work week (for all single females, the coefficient estimates are not significant).

The effect of the wage variable on the hours function is as expected positive. From the all hours function, the effect of an increase in the weekly wage rate of E£1 increases the working week by 1 hour for household heads and divorced females and by just under

10 minutes for never-married and widowed females. In terms of elasticity (calculated from the coefficients of table 5.16), the range is from .019 for never-married females to .43 for divorced females. These results indicate a small responsiveness of hours to wages.

5.5 Estimation Procedure and Definition of Variables

5.5.1 Simultaneous Equations Systems

The aim of this study is to examine the relationship between labour force participation and fertility decisions in a framework where these household decisions are jointly determined. This approach implies that the analysis will take into explicit account the system of relations in which the participation equation is included. The validity of the simultaneous nature of household decision-making implies that application of least squares to a single equation produces biased (and inconsistent) coefficient estimates(3).

Construction of a simultaneous equation model raises a number of problems. The first problem is that of identification, that is model formulation. This means classifying the variables into exogeneous variables; variables that are not explained by the model, but are determined outside the model; and endogeneous variables; variables determined by the model. Choosing some variables as endogeneous to the model is to a certain extent arbitrary, the choice depending on the character and extent to which the system is being studied, the purpose for which the model is built, and, when applicable, the data available.

The second problem concerns estimation of the parameters of the model which depends on the identification of the equations in the system. A function belonging to a system of simultaneous equations

is identified if it has a unique statistical form, that is if no other equation in the system contains the same variables as the function(4). The function may be exactly identified, in which case unique coefficient estimates can be obtained by applying indirect least squares. If the function is over-identified then unique estimates cannot be obtained by indirect least squares and other methods have to be adopted(5). One view, it must be noted, is that any over identified system can be exactly identified by the addition of a significant variable or the removal of an insignificant variable. The function may also be under-identified in which case the statistical form of the function is not unique. Least squares applied to each equation yields reduced-form coefficient estimates.

5.5.2 Specification of the Models

In this section two models based on the joint-determination approach, concerning fertility and labour force participation decisions, are presented. There is no theoretical guidance on model specification, that is, whether these systems are likely to be under-identified, exactly identified or over-identified. However, a number of approaches have been empirically tested.

The approach adopted by Nerlove and Schultz (1970) is one in which a number of variables such as marriage, fertility, migration and labour force participation are specified as endogeneous to the model, but which also enter into the equations determining the other endogeneous variables. Each of the endogeneous variables are also determined by somewhat different exogeneous variables. The resulting system is one that is over-identified with no direct casual relationship (making it unappealing in analysing the

empirical results).

On the other hand, the approach adopted by McCabe and Rosenzweig (1976) is one in which the same set of exogeneous variables affect fertility and participation decisions: their view is that it is impossible to find exogeneous variables which influence labour force participation but not fertility decisions and vice-versa. The view that economic models are generally under-identified is one proposed by Liu (1960)(6). The argument is that most econometric models are incorrectly specified with few explanatory variables appearing in each equation. Removal of variables resulting in over-identification is fictitious because there are too many missing variables from each equation.

McCabe and Rosenweig's (1976) approach is appealing because of the simplicity of the analysis and directness of the estimation procedure: least squares is applied to each equation at a time and reduced-form coefficient estimates are obtained. However, in this case fertility and participation decisions do not directly interact; a number of exogeneous variables affect each variable. In addition, occupational compatibility and child-bearing is also taken as one of the endogeneous variables in the analysis.

In this study a four-equation system (based on Rosenzweig and McCabe) is utilised:

$$D_i = F(\bar{X}, \epsilon_i) \qquad i = 1, 4 \qquad (5.4)$$

Where:

D_1 : CEB = children every born

D_2 : PART = labour force participation

D_3 : LOC = location of work

D_4 : CIND = compatibility index

$\bar{X}$: array denoting set of exogeneous variables

ϵ_i = random error term

These variables will be described in the next section.

One model that has not been theoretically or empirically considered is the recursive model. A feature of this system, unlike the systems previously described, is that it is a casual system. There is a direct relationship between the endogenous variables: in this system it is assumed that fertility decisions affect labour force participation decisions.

Setting out the model, let:

F_1 : completed or planned fertility

F_2 : lifetime participation

$\bar{X}_1$: factors determining fertility

$\bar{X}_2$: factors determining participation (not necessarily the same set as $\bar{X}_1$)

ϵ_1, ϵ_2 : random error terms

cov $(\epsilon_1, \epsilon_2) = 0$

$$F_1 = F(\bar{X}_1, \epsilon_1) \qquad (5.5)$$

$$F_2 = F(F_1, \bar{X}_2, \epsilon_2) \qquad (5.6)$$

The measures used for lifetime participation, completed fertility and their determinants are described in the next section. In this section the theoretical validity of using such a model will be discussed.

A view that is held by some economists is that systems are really recursive(7). Realistically, it is argued, events do not occur simultaneously - there is some adjustment at work. An important factor is the time period involved.

In the household model, the appropriate planning period is considered to be the lifetime. Of interest in this thesis is the work behaviour of females. Therefore the arguement, which is by no means inconclusive, is that females do not consider market participation when planning the number of children they wish to bear, but market participation is effected by the number of children that are born.

Completed fertility is determined by factors such as husband's and wife's educational level, expected earnings of the wife, age at marriage of the wife, family assets and possibily planned market participation of the wife. If planned market participation is of major importance, then the hypothesis is, to some extent, incorrect.

Consideration could also be taken of the opposite view: labour force participation is unaffected by planned fertility, but fertility is affected by the participation status.

The alternative recursive model would be set out as:

$$F_2 = F(\bar{X}_2, \epsilon_2) \quad (5.7)$$

$$F_1 = F(F_2, \bar{X}_1, \epsilon_1) \quad (5.8)$$

5.5.3 Endogeneous Variables

(1) Labour Force Participation

In examining the joint decision of work and fertility, lifetime labour force participation is the variable of interest. The EFS data file contains information on current and past work history of married females. Table (5.17) represents the marital pattern of work. The figures indicate that around 25% of currently married females have participated in the labour market during some period of their lives. In order to construct a good index for lifetime participation information on the number of years spent in full-time or part-time employment is required. This would give the proportion of lifetime the female is engaged in labour market activities. However, this information is not available. A simpler lifetime index, for which data is also unavailable, would be a measure for the continuity of work: in this case, information is needed for the desire to work in the future for the construction of such an index.

In this study, assuming Ben-Porath's hypothesis is correct (that is current participation is a good measure for permanent participation), then participation during a part of the life-cycle is taken as a measure towards life-time participation.

Current participation is also used as an exogeneous variable. Labour force participation can be established from the variables last occupation or work status since marriage. The distribution of

married females according to occupation and work status are given in tables (5.18) and (5.19). The distribution by occupation of urban areas and Cairo are similar, but differ from rural areas where, as expected, the majority of working females are in agricultural activity. The same observation is found for work status. Nearly eighty percent of those who work in urban areas or Cairo are wage-earners; in rural areas nearly sixty percent of females who participated in the labour market are working on the family farm.

Finally, location of work is another variable used. In rural areas fifty nine percent of workers work on the family farm and twelve percent work at home, i.e., the majority work in locations that are compatible with childcare activities. In urban areas and Cairo around eighty eight percent of workers work away from home. Whether these would engage in activities that are compatible with childcare cannot be ascertained from the data file. Distribution of the work force by location of work is presented in table (5.20). The dependent variable used is the location of employment (LOC), which is defined (for the sub-group of workers) to be equal to one if working outside the home and zero otherwise.

Table 5.17 Distribution of Married Females by Marital Pattern of Work

Area	Urban		Rural		All Areas		Cairo	
Pattern of Work								
Now and before	89	(8.5)	175	(11.6)	264	(10.3)	37	(8.2)
Now not before	54	(5.2)	86	(5.7)	140	(5.5)	21	(4.7)
Since and before	18	(1.7)	22	(1.5)	40	(1.6)	7	(1.6)
Since not before	11	(1.1)	12	(.8)	23	(.9)	9	(2.0)
Before only	63	(6.0)	105	(7.0)	168	(6.6)	29	(6.5)
Never worked	809	(77.5)	1109	(73.5)	1918	(75.1)	346	(77.1)
All Females	1044	(100)	1509	(100)	2553	(100)	449	(100)

Figures in brackets are the proportion of the sample.

Table 5.18 Distribution of Married Females by Occupation

Area	Urban		Rural		All Areas		Cairo	
Occupation								
Professional	65	(6.2)	10	(.7)	75	(2.9)	28	(6.2)
Clerical	40	(3.8)	5	(.3)	45	(1.8)	17	(3.8)
Sales	12	(1.1)	19	(1.3)	31	(1.2)	4	(.9)
Agricultural self-employed	2	(.2)	171	(11.3)	173	(6.8)	1	(.2)
Agricultural employed by others	1	(.1)	54	(3.6)	55	(2.2)	-	
Household Services	13	(1.2)	4	(.3)	13	(.5)	7	(1.6)
Other Services	16	(1.5)	31	(2.1)	20	(.8)	8	(1.8)
Skilled Labour	24	(2.3)	2	(.1)	55	(2.2)	10	(2.2)
Unskilled Labour	2	(.1)	-		2	(.1)	-	
Did not work	871	(83.4)	1213	(80.4)	2084	(81.6)	374	(83.3)
All Females	1044	(100)	1509	(100)	2553	(100)	449	(100)

Figures in brackets are the proportion of the sample
- not applicable

Table 5.19 Distribution of Married Females by Work Status since Marriage

Area	Urban		Rural		All Areas		Cairo	
Work Status								
Family Farm	2	(.2)	174	(11.5)	176	(6.9)	1	(.2)
Family paid cash	1	(.1)	-		1	(.0)	1	(.2)
Family paid kind	-		-		-	(.4)	-	
Family unpaid	7	(.7)	4	(.3)	11	(7.6)	3	(.7)
Other paid cash	139	(13.3)	56	(3.7)	195	(.6)	59	(13.1)
Other paid kind	-		15	(1.0)	15	(0)	-	
Other unpaid	-		1	(.1)	1	(2.7)	-	
Self-employed	23	(2.2)	45	(3.0)	68		10	(2.2)
Did not work	872	(83.5)	1214	(80.5)	2086	(81.7)	375	(83.5)
All Females	1044	(100)	1509	(100)	2553	(100)	449	(100)

Figures in brackets are the proportion of the sample.

- not applicable

Table 5.20 Distribution of Married Females by Place of Work

Area	Urban		Rural		All Areas		Cairo	
Location of Work								
Family Farm	2	(.2)	174	(11.5)	176	(6.9)	1	(.2)
Other Farm	1	(.1)	50	(3.3)	51	(2.0)	-	
At home	18	(1.7)	36	(2.4)	54	(2.1)	9	(2.0)
Away from home	151	(14.5)	35	(2.3)	186	(7.3)	64	(14.3)
Did not work	872	(83.5)	1214	(80.5)	2086	(81.7)	375	(83.5)
All Females	1044	(100)	1509	(100)	2553	(100)	449	(100)

Figures in brackets are the proportion of the sample.
- not applicable

(2) Fertility Variables

There are a number of measures to describe different aspects of fertility. Of interest in this study is the level of fertility; measrued by the number of children ever born to the mother. Since the theory concerns decisions about completed fertility levels, this means that the choice of age-group has to represent this phenomena. This is to some extent arbitary and relies in part on background knowledge of fertility behaviour in Egypt. This is provided by the published material from the EFS.

Birth history data can suffer from omission of births, especially by older females. This is shown to be negligible in the EFS data, and so an upper age limit of 49 years (the maximum age reported in the survey) is used. Results from the EFS indicate that Egyptian females start their child bearing experience at roughly the same pace (measured by early marital fertility - the rate of childbearing in the first five years of marriage) regardless of background characteristics, after which certain groups of females start to regulate their fertility. In this case taking an age group of 35-49 seems to be justifiable.

In Egypt marriage preceeds childbirth and, therefore, females in the same marriage cohorts have approximately the same length of exposure to childbearing. Selection of older marriage cohorts (for example those who have been married for at least fifteen years) would represent another measure of completed fertility. The different (and possibly desirable) characteristic of this group of females would be that they represent a broad range of ages.

Finally, an index that is used to assess the importance of the choice of occupation on fertility is used. This index is an ordinal measure of the child-rearing compatibility of the occupation chosen by the wife. The average number of children ever born to females aged 35-44 by occupation is used to represent this index, the most compatible occupations being assigned the highest number.

5.5.4 Exogeneous Variables

Having previously discussed the effects of some of these variables on labour supply behaviour, the description of the effect of the endogeneous variables on the demand for children is considered in more detail. It should also be noted that there is no data concerning the partner's or any of the family member's unemployment status(8).

(1) Wage Variable (WAGE)

An in Part I of this chapter, a wage equation is used to estimate wages for workers and non-workers using a semi-logarithmic empirical specification:

$$\ln W = \alpha_0 + \alpha_1 \text{ YRSCH} + \alpha_2 \text{ AGE} \qquad (5.9)$$

Where:

W : gross monthly earnings

YRSCH : number of completed years of schooling

AGE : age cohort

Analysing the effect of the wage rate on the demand for children, McCabe and Rosenzweig (1976) related it to the time intensity of child services α_n and commodity services α_c. The response for desired number of children depends on the relative intensity of child services relative to commodity services ($\alpha_n - \alpha_c$). A rise in wages will have two effects:

(i) it will increase the price of children relative to commodity services if child time intensity is greater than commodity time intensity;

(ii) it will increase household income which, assuming children can be treated in the same way as normal commodities, should increase the desire for children.

Thus, the effect of child time intensity may be opposite in sign and outweigh the income effect.

The relative intensity of child services relative to commodity services is influenced by a number of factors; the extent to which care for young children is the responsibility of persons other than the mother (older children or relatives); occupational compatibility with child rearing.

These factors differ between societies, but it is assumed that in less developed countries child rearing is less intensive in the mother's time since a characteristic of many developing countries is the ready availability of relatives, older children and domestic servants for child care. It is also assumed that in less-developed countries the mother's occupation is more compatible with child-rearing. If this is the case, then a rise in females wages would increase the desired number of children.

(2) Income Variables (HHI, PCI, PCE, ASSET)

Measures of income levels in the EFS data file that are used in this study are:

(i) Annual household income (HHI). This is divided into five categories (of equal group size) and ordered by increasing level of income.

(ii) Per capita income (PCI). This is also divided into five categories (of equal group size) and ordered by increasing level of income.

(iii) Per capita expenditure (PCE). This measure of economic well-being is correlated with income and is also a categorical variable.

(iv) Physical asset (ASSET). The ownership of a toilet is considered to represent a measure for the level of assets owned by the household. This variable is divided into four groups according to the type of toilet available to the household; (a) flush-family only; (b) flush other; (c) other types and (d) none.

Each of these measures have drawbacks. The relationship between per capita income and household income depends on the relation to family size. Household income might increase with family size since larger families have more potential workers. However, no clear pattern emerges from the data(9).

The relationship between fertility and income is not straightforward. For parents children are a source of psychic income or satisfaction - a consumption good in economic terms

(Becker, 1960). Children may also provide money income. In this case, they can be termed a production good. Price theory indicates that an increase in income increases the amount spent on the commodity (unless it is inferior). That is an increase in income raises the amount spent on children through increases in the quantity (number) and quality. The investments in quality take two forms; good nutrition and health care and; provision of education and attitudes that enable the acquisition of further education and skills. Thus, theory does not guarantee that increases in income increases the desired number of children(10).

(3) Education Variables (LIT, YRSCH, ED, PYRSCH)

Education of parents is associated with a number of aspects of fertility:

(i) It may affect the individuals parent's desire for children as well as possibly the relative importance of the husband's and wife's desire in the household decision making process.

(ii) It affects parental productivity in child rearing and other activities.

(iii) It affects the ability to control the number of births and possibly influence child mortality.

Ben Porath (1973) analyses the effect of education on fertility through their affect on wages and income. Education is related to a higher cost of time of females resulting in a substitution effect against the desire for children. Education is also associated with a higher income (which might have a positive effect on the number of

children). The effect of education on fertility therefore depends on which of these effects is dominant. The husband's level of education is expected to be associated less with the cost of time (since their role in child rearing is much less) and more with income.

Three measures of the wife's educational level are used:

(1) Literacy (LIT); indicating whether a female can read. (This takes a value of 1 if she can read and a value of 2 if she cannot read).

(2) The number of school years completed (YRSCH); this is closely correlated with predicted wage level therefore it is not used in the model with the wage variable.

(3) Attainment of at least a seondary level of schooling (ED). (This takes a value of 1 for those with a primary certificate or less and a value of 2 for those with a secondary or university certificate).

The measure adopted for the husband's educational attainment is the number of school years completed (PYRSCH). If the husband's education is associated with his potential wage (income), then the effect on the desire for children cannot be predicted theoretically.

(4) Age Variables (AGE, AGEM)

In the demand for children function age at marriage is used. Age at marriage is taken as an indicator for the exposure to risk of conception. It is expected that the older the age at marrige the lower the number of children born. The measure taken for age at marriage is the marriage cohort to which the female belongs.

The variable used in the participation function is the age of the female (age cohort to which the female belongs). The age variable in cross-sectional analysis reflects differences between the cohorts as well as the stage in the life-cycle of the female. Taking the 35-49 age-group, it is expected that both effects would lead to a decline in the participation rate.

(5) Additional Variables (HELP, COST)

Certain expectations also play a role in the determination of family size. These expectation depend on what parents want from their children, and what they want to give them(11).

The variables used to measure these expectations are:

(1) The expectation of help from children (HELP). (This is coded 1 if yes and 2 if no).

(2) The desired level of education for their daughters (COST). This is a crude measure of the overall expenditure on children the family would expect to incur.

5.6 Results for the Joint-determination Approach

The results for the models presented in section 5.5.2 are presented in tables (5.21) to (5.27). Table (5.21) is a presentation of the results for the wage function. The model explains at least half (except for Cairo) of the variation in wages between individuals. The regressions and coefficient estimates (in almost all cases) are highly significant. These results are considered to be good.

Table (5.22) presents the average number of children ever-born in each occupation. The ordering of the mean number of children is used to construct the compatibility index (CIND). For urban areas, mothers working in professional and clerical occupations have the least number of children, while those in sales (which could be in the informal sector) have the highest number of children. For all areas professional and clerical workers have the least number of children, while those who work on the family farm and in sales have the highest number of children. These figures seem to indicate that the occupational compatibility hypothesis is to a certain extent correct.

Now, the analysis for each model is presented; begining with the four equation model in which each endogeneous variable is determined by the same set of exogeneous variables.

Table 5.21 Wage Function for Married Females, 25-44

Area / Explanatory Variables	Urban	Urban[a]	Rural	Cairo	All Areas
YRSCH	074 (16.4)**	.076 (17.2)**	.083 (10.6)**	.067 (7.2)***	.084 (23.3)***
AGE	.17 (8.3)***	.16 (9.22)***	.054 (.87)	.15 (3.9)***	.17 (8.1)***
Intercept	1.84 (17.1)***	1.86 (18.8)***	2.01 (7.8)***	2.04 (9.9)***	1.7 (17.7)***
R^2	.50***	.51***	.56***	.38***	.59***
Number in sub-group	305	290	89	98	394

(a) Once-married females
***, **, * 1%, 5% and 10% level of significance

Table 5.22 Average number of children ever-born by occupation married-females, 35-49

Area Occupation	Urban	Urban[a]	Rural	All Areas
Professional	2.74 (27)[2]	2.73 (26)[2]	-	2.74 (27)[2]
Clerical	2.50 (6)[1]	2.50 (6)[1]	-	2.50 (6)[1]
Sales	7.86 (7)[7]	7.17 (6)[7]	7.67 (9)[5]	7.75 (16)[9]
Agricultural-self-employed	-	-	7.46 (65)[4]	7.4 (67)[8]
Agricultural-employed by others	-	-	6.14 (14)[1]	6.20 (15)[4]
Household services	4.82 (11)[3]	5.57 (7)[3]	-	4.82 (11)[3]
Other services	6.54 (11)6	7.13 (8)[6]	-	6.38 (13)[5]
Skilled labour	6.00 (6)[5]	6.20 (5)[5]	7.43 (7)[3]	6.77 (13)[7]
Not employed	6.06 (352)[4]	6.11 (321)[4]	6.97 (393)[2]	6.54 (745)[6]

The figures in brackets are sample sizes.
The number above the brackets represents the ordinal ranking of the mean number of children.

(a) Once-married
- not applicable

Table (5.23) presents the set of household regressions for once-married females in urban areas. (A similar set of results for all areas is presented in Appendix III. No results are presented for rural areas since these were found to be insignificant). The set of exogeneous variables in each equation is significant (in most cases at the 1% level) in explaining the variance of each dependent variable. The emphasis in the analysis of the results in this model is to assess how each variable can provide some information on the relationship between female labour force participation and fertility.

The first two equations in each set of household functions indicate that an exogeneous rise in wages reduces family size and increases the market work performed by mothers : the coefficients of the wage variable in both the CEB and PART equations are statistically significant. (The effect on work performed outside the home is not statistically significant). Thus, for mothers in urban areas, an increase in wages increases the price of child services relative to commodity services, i.e., the relative intensity of child services exceeds that of commodity services. There are a number of factors which influence the relative intensity of child-rearing and commodity services. The results indicate that occupational compatibility is one of those factors. The coefficient estimates for the CIND equations are significant and negative in sign, reflecting the reduction in family size to those mothers with higher wages, most probably in those occupations which are least compatible to child-rearing.

Of the three measures used for the educational variable, only the number of years of schooling is statistically significant in

both the CEB and PART equations. A rise in the number of years spent in education reduces family size and increases market work (the effect on the location of work is insignificant). However, literacy and attainment of a secondary certificate are significant determinants of labour force participation, but act in opposite directions. The compatibility index reflect these results. The greater the number of years spent at school, and, attainment of a secondary certificate places the female in occupations which are less compatible to child-rearing. It is felt that this reflects the wage effect of education. Thus, mothers with high wages (due to higher educational levels) are in the least compatible occupations with regard to child-rearing and have lower fertility levels. This is the expected situation in developed countries.

The coefficient estimate for the husband's number of years of schooling is statistically significant, and negative in sign, only in the CEB equations. The effect of this variable on fertility levels will be discussed in more detail for the recursive model.
The age variable is, as expected, positively related to fertility levels, but negatively related to market participation. One interpretation given to the coefficent in the CIND equations (which in most cases are statistically significant and positive in sign) is that those in the more compatible child-rearing occupations tend to enter (or re-enter) these occupations at older ages, whereas those with the least compatible child-rearing occupations, once leaving work are reluctant to enter at older ages. A second interpretation could be that young working females are entering the professional and clerical occupations than those in the older cohorts as a result of advancement in female education.

Table 5.23 Household Regressions of once-married Females, 35-49, Urban Areas

Explanatory Variables	CEB	PART	LOC	CIND	CEB	PART	LOC	CIND
WAGE	-2.27	.78	-.03	-1.97	-3.4	.18	-.33	-.41
	(-3.4)***	(8.6)***	(-.18)	(-10.6)***	(-3.9)***	(1.6)	(-1.3)	(-1.68)*
LIT	.45	.21	.11	-.64				
	(1.14)	(3.97)***	(.76)	(-5.8)***				
ED					.69	.39	.25	-.93
					(.84)	(3.8)***	(1.03)	(-4.31)***
AGE	.93	-.17	.041	.29	1.12	-.07	.08	.03
	(4.98)***	(-6.65)***	(.75)	(5.6)***	(5.3)***	(-2.5)**	(1.4)	(.56)
PYRSCH	-.12	.001	-.006	-.004	-.13	.0001	-.007	-.001
	(-3.9)***	(.28)	(.58)	(-.5)	(-4.0)***	(.02)	(-.63)	(-.09)
HHINC	.53	-.003	.03	.006	.54	.001	.02	-.005
	(4.7)***	(-.19)	(.69)	(.19)	(4.87)***	(.07)	(.59)	(-.16)
ASSET	.34	.05	-.16	.07	.35	.05	-.15	.061
	(2.38)**	(2.4)**	(-2.24)***	(1.69)***	(2.41)***	(2.52)***	(-2.02)**	(1.49)
Intercept	4.76	-1.72	.88	9.2	7.1	-.56	1.41	5.9
	(2.2)***	(-5.9***	(1.17)	(15.5)***	(4.49)***	(-2.63)	(2.9)***	(13.4)***
R^2	.31***	.24***	.12***	.37***	.31***	.24***	.13***	.34***

***, **, * 1%, 5%, 10% level of significance.

Table 5.23 (cont'd)

Explanatory Variables	CEB	PART	LOC	CIND	CEB	PART	LOC	CIND
WAGE	-1.52	.79	-.056	-1.93	-1.6	.8	-.05	-1.95
	(-2.2)***	(8.72)***	(-.3)	(-10.5)***	(-2.3)**	(8.8)***	(-.3)	(-10.5)***
LIT	.48	.21	.088	-.64	.4	.20	.12	-.65
	(1.19)	(3.9)***	(.64)	(-5.9)***	(1.0)	(3.8)***	(.87)	(-5.9)***
AGE	1.05	-.167	.04	.29	1.02	-.17	.04	.29
	(5.55)***	(-6.6)***	(.74)	(5.7)***	(5.4)***	(-6.7)***	(.722)	(5.6)***
PYRSCH	-.081	.002	-.009	-.002	-.08	.002	-.01	-.002
	(-2.54)**	(.43)	(-.77)	(-.2)	(-2.5)**	(.544)	(-.9)	(-.13)
ASSET	.08	.043	-.16	.05	.03	.037	-.16	.05
	(.55)	(2.16)**	(-2.37)**	(1.3)	(.18)	(1.85)*	(-2.3)**	(1.3)
PCI	-.39	-.02	.035	-.04				
	(-3.54)***	(-1.03)*	(.85)	(-1.3)				
PCE					-.45	-.03	.05	-.03
					(-4.03)***	(-1.72)**	(1.2)	(-1)
Intercept	5.3	-1.7	1.00	9.2	6.04	-1.7	.89	9.3
	(2.44)***	(-5.9)	(1.43)	(15.6)***	(2.8)***	(-5.7)***	(1.25)	(15.5)***
R^2	.29***	.24***	.12***	.37***	.30***	.24***	.13***	.37***

Table 5.23 (cont'd)

Explanatory Variables	CEB	PART	LOC	CIND
YRSCH	-.202	.04	-.009	-.09
	(-5.4)***	(7.8)***	(-.8)	(-8.6)***
AGE	.54	-.04	.033	-.04
	(3.43)***	(-1.71)***	(.72)	(-.09)
PYRSCH	-.12	5.5×10^{-4}	-.01	-.002
	(-3.98)***	(.13)	(-.64)	(-.2)
HHINC	.53	-9×10^{-5}	.019	-.002
	(4.85)***	(-.01)	(.47)	(-.07)
ASSET	.35	.048	-.17	.06
	(2.4)***	(2.43)***	(-2.5)**	(1.5)
Intercept	1.46	.13	1.1	4.3
	(1.41)***	(.93)	(2.97)***	(14.5)***
R^2	.31***	.21***	.13***	.31***

The coefficient estimate for the ASSET variable is statistically significant for all the endogeneous variables in three sets of household regressions. For the interpretation of this variable, the type of toilet available to the household is taken as a measure for the level of assets. A reduction in the level of assets increases family size and at the same time the work performed by the female, (but not outside the home). This relationship of the level of wealth with both the level of fertility and labour force participation is possible if the mothers engage in occupations that are compatible with child-rearing. This appears to be the case since the coefficient estimate in the CIND equations are positive and there is a reduction in the work performed outside the home.

Finally, it is felt that all three income variables (HHINC, PCI, PCE) provide some difficulty in the analysis. All coefficient estimates for these variables are statistically significant in only the CEB equations (except for one case where the coefficient estimate for PCE is statistically significant in the PART equation). A higher income level (HHINC) increases family size. This might indicate that the responsiveness of an increase in income to increasing family size is greater than the responsiveness to increasing the expenditure on children.

Increasing per capita income (PCI) and per capita expenditure (PCE) have a negative effect on fertility levels. A higher level of per capita monthly expenditure is associated with lower fertility levels. Thus, the evidence of the effect of income on fertility levels is not clear cut. Perhaps, most direct relationship is that between the husband's educational level, which is an indication of the husband's income level and is devoid of the complications

associated with the number of workers in the family and fertility levels.

Next, the analysis focuses on the results for the recursive system of equations, which are presented in tables (5.24) to (5.27).

Tables (5.24) and (5.25) represent the set of results for the determination of fertility levels for once-married females by age-group (35-49 years) and by number of years married respectively. For those females aged 35-49 years, the model explains up to fourty percent of the variability in fertility levels for those married for at least fifteen years, the model explans about a quarter of the variability in fertility levels. The following paragraphs are the effect each variable has on the number of children born.

The effect of wages on the number of children born is positive, and the coefficient is statistically significant especially for the equations of females married at least fifteen years (this sub-group includes females of a greater age-span). This would suggest that the income effect of a rise in wages outweighs the negative price effect (or that the price effect itself is positive), and furthermore, the income effect results in an increase in the number of children born. This finding, though using a different sub-group of married females, is different to the previous four equation system. This underlies the difficulty in trying to predict the effect of wages on fertility levels, where the price effect is not obviously negative.

The coefficient estimates for the education variables are all statistically significant (except for females married for over

twenty years). Literacy reduces the number of children born by, on average, one child. A female with at least a secondary level certificate bears, on average, about two children less than a female with a lesser level of education. The number of years of schooling also has a negative effect on fertility levels, and could be a reflection of expected wages. Education is related to a higher cost of female time and the effect of all measures taken for education indicate that there is a substitution effect against the desire for children. Added to this, a higher level of education is also associated with greater contraceptive awareness.

Husband's educational attainment has a significant effect on fertility levels. A higher educational level for the husband associated with higher wages, and also possibly greater contraceptive awareness, reduces the number of children born. The husband's education is less associated with the cost of time than the wife, so, it is expected that his educational level is associated with potential income. It would seem that the income effect acting through the husband's educational level acts to increase the quality rather than the quantity of children.

Household income and asset holdings act in opposite directions on the number of children born. Coefficient estimates for HHINC and ASSET are statistically significant in all equations. However, as stated before, the variable HHINC might be affected by household size, so asset holdings might provide a better index towards the level of wealth. Increasing household income increases, while an increased level of assets reduces the number of children born.

Age at marriage is, as expected, a significant (and improves the explanatory power of the model when used instead of age) determinant of the number of children born since it is a measure for the length of exposure to risk of conception. The average number of children born is reduced by almost one child for each successive marriage cohort.

Finally, the effect of certain expectation of the mother are examined through two variables: the expectation of help from children, and the desired level of education (a measure for expenditure) for their daughters. As expected, the expectation of no help from children reduces the number of children born. The higher the level of education desired for daughters, the lower the number of children born.

Next, there is an assessment of the second function, the participation function in the recursive model, especially with regard to the effect of the imputed children ever born variable. These results are presented in tables (5.26) and (5.27). The set of exogeneous variables contribute more to the explanatory power of the model when the endogeneous variable is current rather than lifetime participation: they explain up to a third of the variation between females.

The coefficient estimates of the imputed CEB variable in tables (5.26) to (5.27) are statistically significant for most equations; being significant at the 1% level for the 25-49 age-group and the 10% level for the 35-49 age-group. On average, the probability of participation of a female is reduced by three to six percent for every additional child that is born. Table (5.28) presents results

for when the actual number of children born is taken as the variable. The coefficient estimates are statistically insignificant in all equations.

These results indicate that completed fertility (i.e., the number of children born) is a significant determinant of both lifetime and current labour force participation. One must also take into account that individual variation (due to 'tastes' for example) are reduced, at least in part, when use of an imputed fertility equation is made. However, these results do not contradict the hypothesis proposed in this recursive system: that participation decisions are dependent on the level of completed fertility.

Table 5.24 Children Ever Born, urban areas, once-married Females 35-49

Explanatory Variables						
WAGE	.36 (.66)	.47 (.88)		.50 (.80)	.75 (1.26)	.07 (.13)
LIT	1.05 (2.99)***	1.06 (3.1)***				.62 (1.8)*
ED				-1.48 (-2.43)***	-1.69 (-2.95)***	
YRSCH			-.14 (-3.92)***			
AGEM	-1.12 (-8.15)***	-1.1 (-7.9)***	-1.04 (-7.68)***	-1.13 (-8.2)***	-1.1 (-8.1)***	-1.1 (-7.9)***
PYRSCH	-.13 (-4.4)***	-.10 (-3.5)***	-.10 (-3.28)***	-.13 (-4.3)***	-.13 (-4.6)***	-.14 (-4.9)***
HHINC	.48 (4.56)***	.44 (4.4)***	.53 (5.2)***	.48 (4.59)***	.31 (3.07)***	.33 (3.3)***
ASSET	.405 (2.94)***	.46 (3.41)***	.35 (2.57)***	.24 (1.87)***	.24 (1.87)*	.21 (1.62)
HELP					-.28 (-1.19)	
COST						-.26 (-2.0)**
Intercept	3.68 (1.8)*	2.96 (1.47)	6.53 (10.6)***	6.6 (4.39)***	7.58 (5.19)***	7.54 (3.54)**
R^2	.37***	.32***	.38***	.37***	.39***	.39***
		(a)			(b)	(b)

***, **, * significant at 1%, 5% and 10% level.

(a) All-married
(b) When applicable

Table 5.25 Children-Ever Born, urban areas, once-married Females, by number of Years married

Number of years of Marriage	15+	15+	15+	15+	15+	2)+
Explanatory Variables		(a)	(a)			
WAGE	1.17 (2.5)**	1.2 (2.58)**	1.07 (2.39)**	1.2 (2.4)**		-.34 (-.4)
LIT	1.29 (4.1)***	1.3 (4.1)***	.97 (3.12)***			.71 (1.59)
ED				-1.97 (-3.4)***		
YRSCH					-.14 (-3.7)***	
AGEM	-.85 (-5.1)***	-.84 (-5.04)***	-.85 (-5.35)***	-.85 (-5.1)***	-.69 (-4.3)***	-.62 (-2.69)**
PYRSCH	-.15 (-5.6)***	-.14 (-5.1)***	-.15 (-5.8)***	-.15 (-5.6)***	-.12 (-4.3)***	-.156 (-4.3)***
HHINC	.38 (3.96)***	.37 (3.8)***	.25 (2.7)***	.38 (3.89)***	.46 (4.86)***	.48 (3.72)**
ASSET	.38 (3.1)***	.35 (2.9)***	.25 (2.1)***	.35 (2.83)***	.32 (2.58)**	.27 (1.63)
HELP		-.44 (-1.97)***				
COST			-.24 (-1.95)*			
Intercept	.71 (.47)	1.36 (.78)	3.5 (1.96)***	4.98 (4.2)***	6.1 (10.5)***	6.3 (2.25)**
R^2	.26***	.26***	.26***	.25***	.25***	.23***

***, **, * significant at 1%, 5% and 10% level.

(a) when applicable

Table 5.26 Current Labour Force Participation of once-married Females, urban areas

Age Group	25-49	35-49	25-49	35-49	25-49	35-49
Explanatory Variables						
WAGE	.802 (12.90)***	.77 (8.4)***			.26 (3.0)***	.17 (1.40)
LIT	.24 (5.82)***	.24 (4.3)***				
ED					.35 (4.84)***	.40 (3.80)**
YRSCH			.04 (7.89)***			
AGE	-.13 (-9.8)***	-.17 (-6.5)***	.001 (.12)	-.04 (-1.8)*	-.04 (-2.2)***	-.07 (-2.3)**
CEB	-.04 (-2.98)***	-.03 (-1.65)***	-.04 (-2.79)***	-.03 (-1.5)	-.04 (-3.1)***	-.03 (-1.64)*
PYRSCH	-.005 (-1.35)	-.004 (-.7)	-.005 (-1.3)	-.003 (-1.7)	-.006 (-1.69)*	-.005 (-.9)
HHINC	.018 (1.4)	.014 (.76)	.02 (1.5)	.018 (1.0)	.02 (1.48)	.017 (1.0)
ASSET	.006 (4.48)***		.06 (4.3)***	.057 (2.8)***	.06 (4.4)***	.055 (2.8)***
Intercept	-1.90 (-9.8)***	-1.6 (-5.5)***	.07 (.8)	.27 (1.60)	-.71 (-4.6)***	-.4 (-1.5)
R^2	.33***	.24***	.32***	.21***	.32***	.24**

***, **, * significant at 1%, 5% and 10% level.

Table 5.27 Lifetime participation of once-married Females, urban areas

Age Group	25-49	35-49	25-49	35-49	25-49	35-49
Explanatory Variables						
WAGE	.83 (11.5)***	.79 (7.5)***			.28 (2.8)***	.05 (.4)
LIT	.27 (5.78)***	.30 (4.7)***				
ED					.34 (4.05)***	.48 (4.0)***
YRSCH			.035 (6.47)***	.03 (4.1)***		
AGE	-.14 (-9.4)***	-.17 (-5.9)***	-.01 (-.8)	-.04 (1.7)*	-.05 (-2.46)**	-.05 (-1.5)
CEB	-.05 (-3.6)***	-.03 (-1.62)***	-.06 (-3.47)***	-.03 (-1.5)	-.06 (-3.7)***	-.03 (-1.6)
PYRSCH	-.01 (-2.5)**	-.005 (-.8)	-.01 (-2.4)**	-.005 (-.8)	-.01 (-2.8)***	-.006 (-1.0)
HHINC	.03 (1.75)*	.03 (1.36)	.03 (1.9)*	.03 (1.5)	.03 (1.8)**	.03 (1.58)
ASSET	.08 (4.43)***	.08 (3.31)***	.07 (4.2)***	.08 (3.25)***	.07 (4.19)***	.07 (3.29)**
Intercept	-1.83 (-8.3)***	-1.76 (-5.2)***	.26 (2.49)***	.28 (1.44)	-.54 (-3.1)***	-.23 (-.8)
R^2	.27***	.19***	.25***	.15***	.26***	.18**

***, **, * significant at 1%, 5% and 10% level.

Table 5.28 Labour force participation, once-married Females, urban areas, actual number of children born

Endogeneous Variable	Current	Current	Lifetime	Lifetime
Age-group Explanatory Variable	25-49	35-49	25-49	35-49
WAGE	.82 (13.2)***	.78 (8.4)***	.85 (11.9)***	.81 (7.6)***
LIT	.19 (5.1)***	.21 (4.0)***	.22 (4.8)***	.27 (4.3)***
CEB	-.004 (-.8)	-.001 (-.2)	-.01 (-1.2)	.0007 (.08)
AGE	-.13 (-9.3)***	-.17 (-6.4)***	-.15 (-8.8)***	-.17 (-5.85)***
PYRSCH	.001 (.2)	.001 (.2)	-.003 (-.8)	.0006 (.13)
HHINC	-.003 (-.3)	-.002 (-.14)	-.003 (-.2)	.009 (.5)
ASSET	.05 (3.7)***	.05 (2.4)**	.05 (3.4)***	.07 (2.9)***

NOTES

1. The specification of the earnings function depends on the age-earnings profile. This is possibly the simplest specification. Alternative specifications would lead to a parabolic or Gompertz curve.

2. Elasticities are calculated at the mean values:

$$n_w = \hat{b}_1 \cdot \bar{x}/\bar{y}$$

where: n_w : wage elasticity
$\bar{x}$: mean value of wage variable
$\bar{y}$: mean value of hours worked

3. The bias arising from the application of least squares to an equation belonging to a system of simultaneous equations is called simultaneous equation bias. It arises from the correlation (dependence) of the explanatory variables (X), with and the random variable ϵ. Because of the dependence of ϵ and X their covariance $\neq 0$:

$$\text{Cov}\ (X_i\epsilon) = E\ (\ [X_i - E\ (X_i)]\ \ [\epsilon_i - E\ (\epsilon_i)]) \neq 0.$$

The problem of simultaneous equation bias is discussed in Koutsoyiannis (1986) pps.331-335.

4. For formal rules of identification see Koutsoyiannis (1986, pps.35-361). Identification conditions for the systems used in this thesis are presented in Appendix III.

5. In Chapter 16, Koutsoyiannis (1986) describes the indirect least squares method (used in the case when the equation is exactly identified) and the methods of instrumental variables and two stage least squares (used in the case when the equation is over-identified). These methods provide estimates for the structural parameters.

6. See Koutsoyannis (1986), Chapter 21 for comparison of the alternative models and econometric techniques.

7. See Johnston (1970, pps. 378-379) for a discussion on recursive systems.

8. The data for husband's occupation does not yield this information.

9. A review of the various income measures and the relationship with a number of variables such as family size and education of the household head is found in Chapter 3 EFS, Vol. III.

10. The fertility decline in developed countries over the past century is attributed to a small quantity elasticity compared to the quality elasticity (Becker, 1960).

11. There is also a risk factor (child mortality) involved, but it will not be included in this study.

CHAPTER VI: CONCLUSIONS

Historical data on the female labour force in Egypt shows a trend that is characteristic of the development process. There was a decline in the crude activity rate from 11.3% in 1937 to 4.8% in 1960 followed by a gradual increase to about 6% in 1980 and to 13.8% in 1984. Comparability of data is hampered by differences with regard to definitions used and age-groups covered. Before the 1960 census, child legislations prohibited the employment of children under twelve years of age(1). Added to this there was probably a stricter definition of working females, especially those who worked on family farms. These factors could explain part of the decline in the activity rate which occured in the 1937-1960 period. It is felt that modifications in procedures regarding the enumeration of females in the labour force since 1983 (especially those females in rural areas) resulted, in part, in the observed increase in the activity rate.

However, over half of the increase in the female labour force between 1960 and 1976 in urban areas can be attributed to the increase in the participation rate. The life-cycle pattern of female labour force participation indicates that married females in Cairo (both for the EFS and LFS) and to a lesser extent in rural areas (LFS) return to work after childbearing age. The return to market participation by married females could partly explain the rising trend in the activity rate.

In Chapter II, an outline of some developments that have influenced the female labour force was presented. And, from these, a number of conclusions were drawn.

An inadequacy of job-creation for the fast increasing work-force has, it is felt, restricted opportunities for female employment outside the home. The existance of such a large proportion of unutilised labour has serious social and economic consequences since productive employment raises income and generates output, as well as provide intellectual rewards to the female(2). In addition, the presence of such a large proportion of unutilised labour raises the dependency ratio (from .79 to 1.43).

The extension of free education until university level has greatly enhanced the status and employment prospects of females, especially in a labour market that is baised towards academic achievement.

Female entry into the labour market has been facilitated by two major developments that resulted in the withdrawal of males from the labour market. The period of military draft was lengthened during the interwar period (1967-1973). After the 1973 war, the political climate in Egypt changed allowing a greater flow of emigrants to the Arab countries. The consequences of the eventual return of migrants is a serious issue.

The aim of this study has been to analyse the labour supply behaviour of females in Egypt within a neoclassical utility maximisation framework. Functions for hours worked and labour force participation are obtained. A two equation model in which the

participation decision is based on the comparison of the market wage and shadow price of time is presented. A procedure is outlined to estimate the parameters of the model. Finally, a joint-determination approach to household decisions is presented to analyse fertility level and participation decisions.

Three data sets were used to analyse the work behavious of females: cross-section survey data collected in Egypt in 1984 (LFS) and in 1980 (EFS) and the 1976 published census data.

As mentioned in the introduction, policy formulation requires knowledge of the effect of economic and non-economic variables on the work behaviour of females. Of course, this depends on the fact that the statistical relationships observed represent a reliable base for formulation of policy. It is not possible to directly compare the results between the three data sets. However, conformity in the size, and magnitude of parameter estimates would, at least, indicate the validity of the observed relationships.

First of all, the results obtained using the LFS and census data are examined (Chapter IV and V: Part I).

The effect of gross wages on work behaviour seems to indicate that females are not very responsive to monetary incentives. Gross wage elasticities for married females ranged from .13, with respect to hours of workers, to .54 with respect to participation, on the aggregate level. On the individual level, the results indicate a gross wage elasticity of .02 with respect to hours.

Comparison of the elasticity measures with those obtained form other studies would give a better indication of the Egyptian estimates. Mincer (1962) obtained a gross wage elasticity of 1.33 for aggregate regressions between metropolitan areas in North America using 1950 census data. Cain (1966) using aggregate census data for 1940 obtained a value of (.80). For Great Britain, Greenhalgh (1977) using aggregate data for 1971 obtains gross wage elasticities between 1.1 and 1.35. Finally, Layard et al (1980) using individual data from the 1974 General Household Survey obtains gross wage elasticities of .08 to .049.

For single females, the effect of wages on the work behaviour of females is positive, but less responsive than for married females. The gross wage elasticity is (.25) on the aggregate level. On the individual level gross wage elasticity is less (.02) and for different marital status groups is lowest for never-married females (.02) and greatest for divorced females (.43).

Income elasticities are also weak (-.1 to -.13) for married females and (-.12 to -.21) for single femaels. An inelastic response of participation and hours worked to income is also observed in the studies listed for the wage variable: -.83 for Mincer's study, -.4 for Cain's study; -.003 to -.32 for Layard et al; and -.88 to -.94 for Greenhalgh. The income variable on the individual level has the opposite effect on work behaviour (the coefficient estimate being positive). This is contrary to theoretical expectation. An explanation could be that this measure for income is not adequate. Overall, however, the elasticity magnitudes indicate that females are more responsive to their own-wage than to other income (or husband's wage).

To summarise, females are more responsive to changes in their own wage than income of other family members. The responsiveness is greater for married than single females. An inelastic response of participation and hours worked to own wage could be changed by changes in the wage system which, as stated in Chapter II, places too little emphasis on incentives and bonuses.

Job opportunities, or the probability of finding a job, are important in the participation decision. In most cases a discouraged-worker effect is observed. This is the case for married females on the aggregate and individual level and for single females in all marital status groups on the individual level. For single females on the aggregate level an added worker-effect is observed, especially for divorced females and married household heads - possibily the result of financial pressure.

The strong, possibly major, influence of education on the participation decision and hours of work is the opposite of what is expected on the basis of economic need (if we expect better educated females to belong to higher income households). But, as stated before, educational attainment is associated with higher wages and also enterance to better quality work. The coefficient estimates from census data for 1976 is 1.13-1.15 which is very close to the estimates obtained by Schultz (1972) who used the same measure of education in regression on activity rates (Shultz's estimates range from 1.13-1.49). The LFS coefficient estimates are similar to those obtained from census data (.72-.9). The coefficient estimates from the EFS are lower (.34-.48),

For the single marital status groups divorced females have the highest coefficient estimates (both for individual and aggregate data). Coefficient estimates range from .62 to .97 for the education variable in the participation function.

It is felt that the relationship between labour force participation and fertility levels examined through a joint-determination approach using EFS provides a more informative picture of the fertility-participation decision than a single-equation approach.

Aggregate results do not indicate any significant relationship between fertility levels and labour force participation for married females (LFS). However, there is a significant relationship between hours of mothers and the child per woman ratio. These results seem to agree with other studies such as Greenhalgh's (1977) and Layard et al (1980). Family size exerts a negative effect on the labour force participation of single females, and the relationship is significant for participation and hours worked. Census results also indicate the same results, i.e., that the child per woman ratio is not significant. However, other measures of fertility levels show a significant relationship with participation, but there is no uniformity. The results do not reject those obtained by Bindary et al (1973), who used 1960 census data for Egypt and indicated that an increasing child per woman ratio depresses participation in urban areas and increases participation in rural areas.

The results on the individual level indicate a clearer pattern. Participation of married females is effected by the presence and number of children under the age of three, but not older children. The probability of participation for a married woman is reduced by eight percent for the presence of a child under three years of age and by a further five percent for every additional child under three years of age.

In the joint-determination approach, an increase in wages simultaneously increases labour force participation and reduces the number of children born. The fertility-wage-participation relationship is statistically significant. McCabe and Rosenzweig (1976) observed that for Puerto Rico increases in wages increases participation and number of children born (non-farm married females).

It would seem, that, for urban areas in Egypt there is no complementary between child-rearing and market work.

The fertility-education-participation relationship is statistically significant for the measure of education: number of school years completed. It is felt that this reflects the wage effect through education. Husband's education is also important in the determination of the number of children born (but not the wife's participation decision). It is felt that this provides the most direct measure of the household's income level.

Finally, the results of the recursive model indicate a statistically significant relationship between completed fertility and participation. The probability of participation is reduced by

three to six percent for every child born.

The conclusion reached is that family size goals can be influenced through education which induces the females to participate in the labour market this would mean that employers have to be encouraged to like females and that education to secondary level becomes for females a main aim in government policy.

NOTES

1. See Nagi (1971) for further details regarding this and other legistlations.

APPENDIX I

A3.1 GRAPHICAL PRESENTATION OF THE LABOUR SUPPLY PROBLEM

Figure A3.1 depicts a set of indifference curves I_1-I_3. Each indifference curve is a loci of points showing the combination of income and leisure time which give the same level of satisfaction or utility.

T is the time constraint

W_1 - W_3 represent wage constraint at different wage levels

Optimality for the different wage levels is at M_1, M_2 and M_3 which in each case maximises utility because the individual is on the highest possible attainable indifference curve.

In Figure A3.2 one can see the case where there is non-participation. The indifference curves in this case are very steep and they show that there is a high subjective evaluation of non-market time relative to income.

HN: represents the availability of non-labour income which could be husband's earnings.

NW: represents the wage rate if the woman were to work.

The optimum position is achieved at N where the woman is devoting all her time to non-market activities.

A female only works when her potential wage exceeds the subjective evaluation of her time.

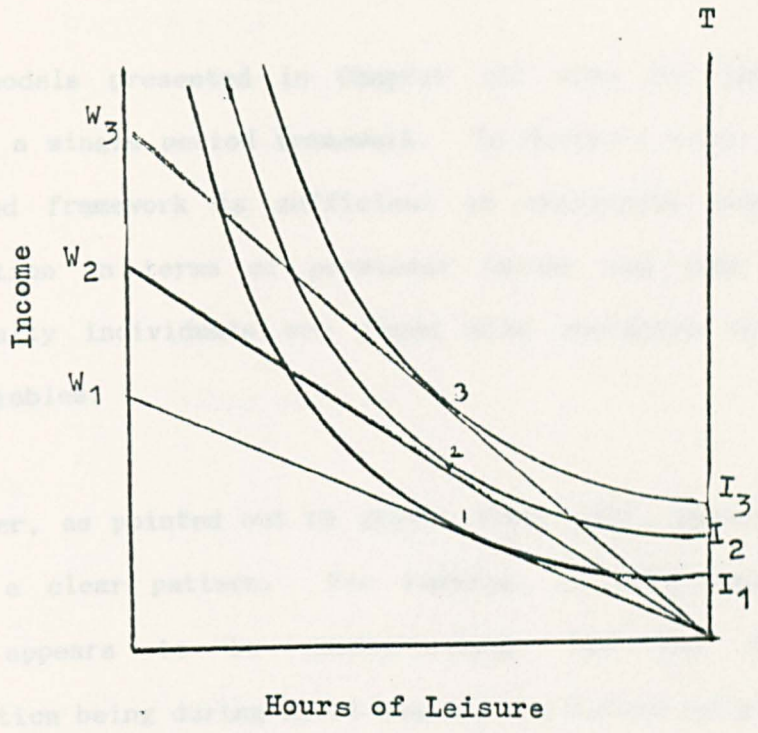


Figure A3.1

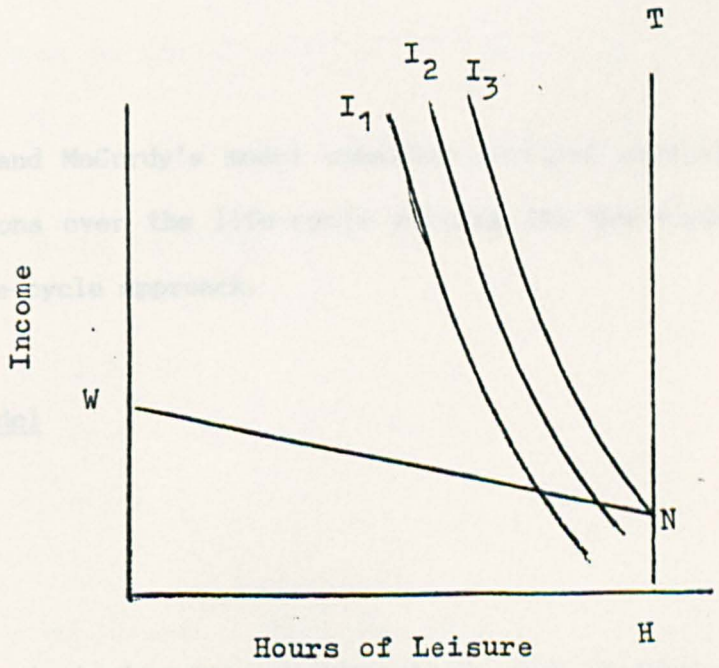


Figure A3.2

A3.2 LIFE-CYCLE MODEL OF LABOUR SUPPLY

The models presented in Chapter III view the labour-leisure choice in a single period framework. In Mincer's model (1962), the one period framework is sufficient in explaining average market participation in terms of permanent income and wage rates, but realistically individuals are faced with variation in wages and other variables.

However, as pointed out by Smith (1980, p12), age-work profiles indicate a clear pattern. For females, US data show that this profile appears to be double-peaked: the two declines in participation being during child-bearing and before retirement.

The life-cycle models developed explain timing decisions in terms of differences between rates of interest, time preference and wage rates.

Heckman and MaCurdy's model consider distinct participation and hours functions over the life-cycle merging the Ben-Porath approach with the life-cycle approach.

Heckman's Model

Let:

C (t) : instantaneous consumption of goods at time t

L (t) : instantaneous leisure at time t

U_t : utility function at time t

W (t) : wage rate at time t (assumed to be exogeneous)

$I(0)$: initial assets

r : borrowing rate

ρ : rate of time preference

T : lifetime horizon

$\lambda(0)$: lagrange multiplier

The individual problem is then to maximise lifetime utility according to the following equation:

$$U = \int_0^T e^{-\rho t} [G(C(t), J(L(T))] \, dt$$

Subject to the constraint:

$$I(0) = \int_0^T e^{-rt} [C(t) - W(t)(1-L(t))] \, dt$$

In this case, prices of goods are assumed to be unity and L(t) is a fraction of 1.

Optimising gives the conditions:

$$G'(C(t)) = e^{(\rho-r)t} \lambda(0)$$

$$J'(L(t)) \geq e^{(\rho-r)t} \lambda(0) W(t)$$

$$\lambda(t) = \lambda(0)e^{-rt}$$

As before an equation for the demand for leisure time is obtained.

$$L(t) = L(e^{\rho-r)t} \lambda(0) W(t)) =$$

$$L(t) = L^* (e^{(\rho-r)t} \lambda(0) W(t)) \text{ if } J'(L(t) = e^{(\rho-r)t} \lambda(0) W(t)$$

$$L(t) = 1 \qquad \text{if } J'(1) > e^{(\rho-r)t}\,\lambda(0)\,W(t)$$

Where L^* is the inverse function of J'

The last equation indicates that participation occurs if

$$h(t) = h\,(e^{(\rho-r)t}\,\lambda(o)\,W(t))$$

$$HH = \int_o^T h(t)\,dt = \int_o^T h(e^{(\rho-r)t}\,\lambda(o)W(t))dt$$

$$P = \int_o^T I(t)dt$$

APPENDIX II

Table A4.1 Aggregate Study using Census Data, 1976 Males

Area	All Areas		Urban Areas		Rural Areas	
Explanatory Variables	D1	D2	D1	D2	D1	D2
LMW	$9x10^{-5}$ (1.65)	$4x10^{-5}$ (1.2)				
LFW	$-10x10^{-6}$ (-1.37)	$-3x10^{-5}$ (-.7)				
UN	-2.2 (-2)*	-1.1 (-1.6)	-.1 (-.2)	-1.7 (-2.3)**	-2.3 (-2.5)**	-1.6 (-3)**
ED	-1.7 (-3.4)**	-1.4 (-4.4)**	-.9 (-45)**	-1.3 (-47)**	-4.5 (-4.2)**	-2.3 (-3.7)**
MRR	-.18 (-.4)	-.12 (-.5)	.39 (2.1)**	.14 (.56)	-.2 (-.5)	-.1 (-.7)
CH1	-7.3 (-2.4)**	-2.7 (-1.4)	-4.1 (-2.8)**	-7.4 (-4)**	-2.9 (-1.3)	.4 (.3)
CH2	.60 (.45)	.07 (.08)	-.35 (-.6)	.01 (.02)	-1.4 (-1.4)	-.8 (-1.4)
CH3	-.36 (-.24)	-.24 (-.24)	.08 (.9)	.06 (.5)	-.3 (-.2)	.4 (.4)
Migration	.0005 (.11)	.0008 (.3)				
Intercept	1.06 (3.4)**	1.08 (5.2)**	.68 (3.8)**	.82 (3.6)**	1.2 (4.4)**	1.1 (7.1)**
R^2	.74	.77	.82	.77	.67	.65

***, **, * 1%, 5%, 10% level of significance.

APPENDIX III.1

Table A5.1 Ratio of the Probit Coefficients to the Coefficient of the Hours Function, Married Females

Variable	Ratio(1)
ED	.296*
AGEGRP	.019*
INC	.292*
DCH1	.066*
DCH2	-.37
DCH3	.01
NCH1	.09*
NCH2	-.15
NCH3	.2
AYCH	.08
INTERCEPT	.008

* Coefficient statistically significant in both functions.

(1) Ratio of the probit coefficient to the coefficient in the hours of workers function.

Table A5.2 Ratio of the Probit Coefficient to the Coefficients of the Hours Function, Single Females

Sub-group/ Variable	Ratio(1) 1.1	2.1	3.1	4.1	5.1
ED	.296*	.4*	20	.62	.092*
AGEGRP	.125*	.11	-.019	.015	.83
INCGRP	5	-.056	1.42	-.19	-.2
FMZ	-.24	-.012	-.36	-.63	
HEAD	.06*		.725	-.04	.02
SING	.11				

* Coefficient statistically significant in both functions.

(1) Ratio of the probit coefficient to the coefficient in the hours of workers function.

Table A5.3 Hours Function of all Married Females, 25-49

(using IW)

Explanatory Variables	1.1	1.2	2.1	2.2	3.1	3.2
ED	21 (10)***	17 (6.5)***	20 (11)***	18 (7.8)***	-	-
UN	-1.6 (-2)**	-1.7 (-1.8)*	-1.6 (-2)**	-.16 (-1.8)*	-.6 (-.5)	-.3 (-.4)
AGEGRP	-1 (-.5)	-5.4 (-2.6)***	-2 (-1.4)	-5 (-6.7)***	-15 (-20)***	-14 (-24)***
INCGRP	2.5 (5.3)***	3.4 (6.7)***	2.5 (5.3)***	3.4 (6.7)***	3.6 (6.2)***	2.2 (4.)***
DCH1	-1 (-2.1)**	-1.1 (-2.2)**				
DCH2	.14 (.3)	.5 (.9)				
DCH3	-.03 (-.07)	-.3 (-.5)				
NCH1			-.6 (-1.9)*	-.8 (-2.1)***		
NCH2			.16 (.5)	.4 (1.2)		
NCH3			-.1 (-.5)	-.2 (-.8)		
AYCH					.13 (1.6)	-15 (2.1)**
IW	1 (.2)	12.7 (2.2)**	4.6 (1.1)	11.6 (2.4)**	55 (33)***	56 (40)***
Intercept	-30 (-1)	-102 (-2.8)	-53 (-2)**	-96 (-3)***	-378 (-33)***	-383 (-39)***
R^2	.40***	.44***	.40***	.44***	.44***	.41***

*,**,*** significant at the 10%, 5% and 1% level respectively.

Table A5.4 Hours Function of all Single Females using IW, 25-59

Explanatory Variables	1.1	1.2	2.1	2.2	3.1	3.2
IW	38.7 (23)***	38.7 (10.2)***	33.3 (13.5)***	44.5 (19.8)***	82 (13)***	97 (12.6)***
UN	4.9 (-5.1)***	-3.2 (-1.3)	-2.6 (1.76)*	-4.7 (3.69)**	-6.7 (-4)***	-5.7 (-3)***
AGEGRP	-14 (-15.9)***	-16.6 (-7.2)***	-11 (-9.4)***	-18 (-14)***	-13 (-4.6)***	-13.7 (-6)***
INCGRP	11.2 (14.5)***	3.3 (1.69)*	11.3 (10.8)***	3.1 (3.1)***	18.4 (10)***	2.5 (1.5)
FMZ	-.2 (-1.8)*	-.9 (-1.7)*	-.1 (-.8)	-.4 (-2.3)**	-.8 (-2.2)***	-.6 (-1.5)
HEAP	4.86 (5.4)***		7.6 (5.8)***	9.7 (2.4)***	19.5 (3.6)***	4.1 (1.5)
SING	5.3 (5.5)***	16.4 (2.8)***				
Intercept	-267 (-22)***	-236 (-8)***	-288 (-14)***	-287 (-18)***	-591 (12)***	-661 (-8)***
R^2	.41	.37	.34	.40	.40	.34

*,**,*** significant at the 10%, 5% and 1% level respectively.

Note: In regressions the IW variable replaced the education variable.

Table A5.4 - cont'd

4.1	4.2	5.1	5.2
46	48	22	25
(8.1)***	(6.4)***	(7.8)***	(6.2)***
.9	6.3	-1.1	-2.6
(.2)	(1)	(-.8)	(-1)
-21	-22	-8.2	-13.6
(-6)***	(-4.9)***	(-4.8)***	(-4.3)***
10.2	-3.8	6.9	3.2
(4)***	(1)	(6.2)***	(1.7)***
-1.3	-2	-.1	-.2
(-2.2)**	(-2.6)***	(-.6)	(1)
4.1	2.7	4.2	6.5
(1.5)	(.6)	(3.2)***	(3.2)***
-306	-295	-152	-153
(-8)***	(-5.8)***	(-7.8)***	(-5.2)***
.48	.49	.16	.15

APPENDIX III.2

Identification conditions for the simultaneous equations models

The conditions for identification are:

(1) The order condition. A necessary, but not sufficient condition for an equation to be identified: the total number of variables excluded from it, but included in other equations must be at least as great as the number of equations of the system less one.

(2) The rate condition. In a system of G equations, any particular equation is identified it is ossible to construct at least one non-zero determinant of order (G-1).

Model I : The Four-equation system

Number of variables (endogeneous and exogeneous) in the system, K=10.

Number of variables in a particular equation, M=7.

Total Number of endogeneous variables (equations) = 4

Order condition:

$(K-M) \geq (G-1)$

$(10-7) = 3 \geq 3$

Therefore, the order condition is satisfied.

Setting up a table of parameters of model, 4 determinants of order (4+1) = 3 are obtained.

As an example, take the first equation for (CEB) and form the following determinant:

$$\Delta_1 = \begin{vmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

$$\Delta_1 = -1 \neq 0$$

Hence, the equation is not identified. It also follows that:

$$\Delta_2 \neq 0,\ \Delta_3 \neq 0,\ \Delta_4 \neq 0$$

Hence, the system of equations is under-identified. Reduced-form coefficients are estimated using least squares.

Model II : The Recursive System

The system contains two equations:

$$CEB = \alpha_0 + \alpha_1\ WAGE + \alpha_2\ LIT + \alpha_3\ AGEM + \alpha_4\ PYRSCH + \alpha_5\ HHINC + \alpha_6\ ASSET \quad (1)$$

$$PART = \alpha_0 + \alpha_1\ WAGE + \alpha_2\ LIT + \alpha_3\ AGE + \alpha_4\ PYRSCH + \alpha_5\ HHINC + \alpha_6\ ASSET + BCEB \quad (2)$$

	β's of the endogeneous variable	
	CEB	PART
CEB	1	0
PART	$-\beta$	1

The array is triangular : the main diagonal contains 1's and the coefficient above it is zero. The system is recursive and equations are estimated using least squares.

Table A5II.1 Household Regressions of once-married Females, All-Areas, 35-49

Explanatory Variables	CEB	PART	LOC	CIND
WAGE	-1.68 (-2.96)***	.72 (9.2)***	-.03 (-.18)	-1.89 (-8.4)***
LIT	.68 (1.9)*	.26 (5.34)***	.110 (.75)	-.54 (-3.9)***
YRSCH				
AGE	.86 (5.65)***	-.13 (-6.3)***	.04 (.75)	.34 (6.2)***
PYRSCH	-.07 (-2.58)***	-.003 (-.9)	-.006 (-.58)	-.02 (-1.57)
HHINC	.38 (5.1)***	-.003 (-.3)	.03 1.69	-.03 (-.9)
ASSET	.4 (3.57)***	.047 (3.1)***	-.16 (-2.23)**	.13 (2.9)***
Intercept	3.04 (1.76)*	-1.67 (-7.1)***	.88 (1.17)	9.14 (13.4)***
R^2	.19***	.10***	.12**	.22***

Table A5II.1 cont'd

Explanatory variables	CEB	PART	LOC	CIND
YRSCH	-.2 (-5.6)***	.04 (7.4)***	-.005 (-.36)	-.11 (-78)***
AGE	.58 (4.9)***	-.012 (-.7)	-.09 (-2.0)**	-.055 (1.2)
PYRSCH	-.07 (-2.64)***	-.004 (-1.1)	.02 (1.5)	-.02 (-1.44)
HHINC	.38 (5.1)**	-.003 (-.3)	.06 (1.93)*	-.03 (-.88)
ASSET	.41 (3.69)***	.05 (3.3)***	-.15 (-2.36)**	.12 (2.65)***
Intercept	1.48 (1.85)*	.05 (0.44)	1.2 (-2.36)**	4.9 (2.65)***
R^2	.19***	.07***	.33***	.21***

REFERENCES

Amsden, A. (1980). Introduction. In: The Economics of Women and Work, ed. by A. Amsden (London: Penguin).

Arman, I. (1982). Manpower and Employment of Egypt 1980-2000. Memo No. 1320. (Cairo: Institute of National Planning).

Ashenfelter, O. and Heckman, J. (1973). Estimating Labour Supply Functions. In: Income Maintenance and Labor Supply, ed. by G. Cain and H. Watts. (Chicago: Rand McNally College).

Ashenfelter, O. and Heckman, J. (1974). The Estimation of Income and Substitution Effects in a Model of Family Labor Supply. Econometrica 42(1): 73-85.

Ashton, W. (1972). The Logit Transofrmation. (London: Griffin).

Bannock, G., Baxter, R. and Rees, R. (1984). Dictionary of Economics. (Middlesex: Penguin).

Becker, G. (1960). An Economic Analysis of Fertility. In: Demographic and Economic Change in Developed Countries: A Conference of the Universities - National Bureau Committee for Economic Research. Princeton: Office of Population Research, Princeton University, pp. 209-230.

Becker, G. (1965). A Theory of the Allocation to Time. The Economic Journal 75: 493-517.

Becker, G. and Ghez, G. (1975). The Allocation of Time and Goods over the Life-cycle. (New York: National Bureau of Economic Research).

Becker, G. (1981). A Treatise on the Family. (London: Harvard University Press).

Ben-Porath, Y. (1973a). Economic Analysis of Fertility in Israel: Point and Counter-point. Journal of Political Economy 81(2): S202-233.

Ben-Porath, Y. (1973b). Labour-Force Participation and the Supply of Labor. Journal of Political Economy 81(3): 697-704.

Bindary, A., Baxter, C. and Hollingsworth, I. (1973). Urban-Rural Differences in the Relationship between Woman's Employment and Fertility: A Preliminary Study. Journal of Biosocial Science 5: 159-167.

Bishrat, L. (1985). The Census as a Measurement Tool: On the effect of coding practices. In: Population Factors in Development Planning in the Middle East. (Cairo: Population Council).

Boserup, E. (1970). Women's Role in Economic Development. (London: George Allen and Uwin)

Boserup, E. (1981). Population and Technology. (Oxford: Basil Blackwell).

Bowen, W. and Finegan, T. (1969). The Economics of Labor Force Participation. (Princeton: Princeton University Press).

Cain, G. (1966). Married Women in the Labour Force: (Chicago: Chicago University Press).

Cain, G. and Watts, H. (1973a). Introduction. In: Income Maintenance and Labor Supply, ed. by G. Cain and H. Watts. (Chicago: Rand McNally College).

Cain, G. and Watts, H. (1973b). Towards a Summary and Synthesis of the Evidence. In: Income Maintenace and Labor Supply, ed. by G. Cain and H. Watts. (Chicago: Rand McNally College).

Careton, R. (1965). Labour Force Participation: A Stimulus to Fertility in Puerto Rico? Demography 2: 233-239.

Central Agency for Public Mobilisation and Statistics (1978). Population Census 1976. (Cairo: Central Agency for Public Mobilisation and Statistics).

Clogg, C. (1982). Cohort Analysis of Recent Trends in Labour Force Participation. Demography 19(4): 459-479.

Cogan, J. (1980). Married Women's Labour Supply: A Comparison of Alternative Estimation Procedures. In: Female Labor Supply: Theory and Estimation. (Princeton: Princeton University Press).

Denton, F. and Spencer, B. (1973). Fertility, Income and the Labor Force Participation of Married Women. (Hamilton, Ontario: Department of Economics, McMaster University).

D'Oliveria, D. (1978). Labour Supply and Employment in Belo Horizonte, Brazil. PhD Thesis: London School of Economics, Department of Economics.

Finney, D. (1962). Probit Analysis. (Cambridge: Cambridge University Press).

Friedman, D. (1982). Income and Fertility: The Elusive Relationship. Demography 19(1): 65-78.

Gardner, B. (1973). Economics of the Size of North Carolina Rural Families. Journal of Political Economy 81(2): S99-122.

Goldstein, S. (1972). The Influence of Labour Force Participation and Education on Fertility in Thailand. Population Studies 26: 413-436.

Green, H. (1971). Consumer Theory. (London: Penguin Books).

Greenhalgh, C. (1977). A Labour Supply Function for Married Women in Great Britian. Economica 44: 249-65.

Gronau, R. (1973a). The Effect of Children on the Housewife's Value of Time. Journal of Political Economy 81(2): S168-99.

Gronau, R. (1973b). The Intrafamily Allocation of Time: The Value of a Housewife's Time. American Economic Review 63(4): 634-51.

Gronau, R. (1977). Leisure, Home Production and Work - The Theory of the Allocation of Time Revisited. Journal of Political Economy 85 1099-123.

Hansen, B. and Radwan, S. (1982). Employment Opportunities and Equities in Egypt. (Geneva: International Labour Organisation).

Heckman, J. (1974). Shadow Prices, Market Wages and Labor Supply. Economica 42(4): 679-694.

Heckman, J. (1978). A Partial Survey of Recent Research on the Labor Supply of Women. American Economic Review 68(2): 200-207.

Heckman, J. (1980). Sample Selection Bias as a Specification Error. In: Female Labor Supply: Theory and Estimation. (Princeton: Princeton University Press).

Heckman, J. and MacCurdy, T. (1980). A Life-cycle Model of Female Labour Supply. Review of Economic Studies 47: 47-74.

Hicks, J. (1968). Value and Capital. (Oxford: Clarendon Press).

Henderson, J. and Quandt, R. (1971). Microeconomic Theory. (London: McGraw Hill).

Ibrahim, B. (1985). Women's Economic Participation: On Urban Egypt. In: Population Factors in Development Planning in the Middle East, ed. by Shorter and Zurayk. (New York: Population Council).

Ikram, (1980). Economic Management in a Period of Transition. (London: John Hopkins University Press).

International Labour Organisation Yearbook of Labour Statistics (1965-1980). (Geneva: International Labour Organisation).

Issawi, C. (1965). Egypt in Revolution: An Economic Analysis. (London: Oxford University Press).

Johnston, J. (1972). Econometric Methods. (London: McGraw Hill).

Joshi, H., Layard, R. and Owen, S. (1981). Female Labour Supply in Post-War Britain: A Cohort Approach. Discussion Paper No. 79, Centre for Labour Economics, London School of

Economics.

Joshi, H. and Owen, S. (1981). Demographic Predictors of Women's Work Participation in Post-War Britain. Discussion Paper No. 81-3, Centre for Population Studies, London School of Hygiene and Tropical Medicine.

Khandker, S. (1987). Women's Time Allocation and Household Non-Market Production in Rural Bangladesh. Journal of Developing Areas 22: 85-102.

Killingsworth, M. (1983). Labor Supply. (London: Cambridge University Press).

Korayem, K. (1984). Government Policies and the Labour Market in Egypt. External Memo No. 1393 (Cairo: Institute of National Planning).

Koutsoyannis, A. (1986). Theory of Econometrics. (London: Macmillan).

Layard, R., Barton, M. and Zabalza, A. (1980). Married Women's Participation and Hours. Economica 47: 51-72.

Lewis, A. (1954). Economic Development with Unlimited Supplies of Labour. Manchester School.

Lewis, H. (1957). Hours of Work and Hours of Leisure. In: Industrial Relations Research Association, Proceedings of the Ninth Annual Meeting. (Madison (Wisc): Industrial

Relations Research Association).

Long, C. (1958). The Labor Force under Changing Income and Employment. (Princeton: Princeton University Press).

Mabro, R. (1967). Industrial Growth, Agricultural Under-Employment and the Lewis Model: The Egyptian Case 1937-1965. Journal of Development Studies 3: 322-51.

McCabe, J. and Rosenzweig, M. (1976). Female Labour-Force Participation, Occupational Choice, and Fertility in Developing Countires. Journal of Development Economics : 141-160.

McConnell, C. and Brue, S. (1986). Contemporary Labor Economics. (London: McGraw Hill).

Michael, R. (1973). Education and the Derived Demand for Children. Journal of Political Economy 18(2):S128-163.

Mincer, J. (1962). Labor Force Participation of Married Women: A Study of Labor Supply. In: National Bureau of Economic Research: Aspects of Labor Economics. (Princeton, N.J.: Princeton University Press).

Mincer, J. (1974). Schooling, Experience and Earnings. (London: Columbia University Press).

Mott, L. (1972). Fertility, Life Cycle Stage and Female Labour Force Participation in Rhode Island. A Retrospective

Overview. Demography 9(1): 173-185.

Nagi, M. (1971). Labour Force and Employment in Egypt: A Demographic and Socioeconomic Analysis. (London: Praeger).

Nassef, A.F. (1980a). The basic features of the Labour Force in Egypt. 1960-1976. (International Labour Organisation Employment Strategy Mission to Egypt Cairo).

Nassef, A.F. (1980b). Demographic Developments in Egypt 1960-1976. (Cairo: International Labour Organisation).

Nerlove, M. (1974). Household and Economy: Toward a New Theory of Population and Economic Growth. Journal of Political Economy 82(2): S200-218.

Nerlove, M. and Press, J. (1973). Univariate and Multivariate Log-linear and Logistic Models. No. R-1306-EDA/NIH. (Santa Monica: Rand Corporation).

Nerlove, M. and Schultz, T. (1970). Love and Life between the Census. R.M.-6322-AID. (Santa Monica: RAND Corporation).

Okijie, C. (1985). Determinants of Labour Force Participation of Urban Women in Nigeria: A Case Study of Benin City. Nigerian Journal of Economic and Social Studies: 39-59.

Philips, L. (1974). Applied Consumption Analysis. (amsterdam: North Holland).

Rees, A. (1979). The Economics of Work and Pay (London: Harper and Prow).

Reid, M. (1934). Economics of Household Production. (London: Chapman and Hall Ltd.).

Robbins, L. (1930). Note on the Elasticity of Demand for Income in terms of Effort. Economica 10: 123-9.

Schultz, T.P. (1972). Fertility Patterns and their Determinants in the Arab Middle East. In: Economic Development and Population Growth in the Middle East, ed. by C. Cooper and S. Alexander. (New York: American Esevier).

Schultz, T.P. (1973). Birth Rates in Taiwan. Journal of Political Economy 81(2): S238-288.

Schultz, T.P. (1980). Estimating Labor Supply Functions for Married Women. In: Female Labour Supply: Theory and Estimation, ed. by Smith. (Princeton: Princeton University Press).

Schultz, T.W. (1974). The High Value of Human Time: Population Equilibrium. Journal of Political Economy 82(2): S2-10.

Schultz, T.P. (1981). Economics of Population. (London: Addison Welsley).

Seatherum, K. (1983). A Profile on Labour Force Implications of Population Change and Educational Development in Egypt.

Report No. EGY/78/P02.

Serageldin, I., Socknat, J. and Birks, J. (1983). Human Resources in the Arab World: The Impact of Migration. In: Arab Resources, ed. by I. Ibrahim. (London: Croom Hill).

Shorter and Zurayak (1985). Population in Factors in Development Planning in the Middle East. (Cairo: Population Council).

Smith, P. (1980). Introduction. In: Female Labor Supply: Theory and Estimation, ed. by P. Smith (Princeton: Princeton University Press).

United Nations (1987). Demographic Yearbook 1985. (New York: United Nations).

Walters, A. (1970). An Introduction to Econometrics. (London: Macmillan).

Willis, R. (1973). A New Approach to the Economic Theory of Fertility Behaviour. Journal of Political Economy 81(2): S14-64. World Fertility Survey. Egyptian Fertility Survey 1980. Vols. I-IV. (Cairo: Central Agency for Public Mobilisation and Statistics).

Yotopoulos, P. and Nugent, J. (1976). Economics of Development. (London: Harper and Row).

Youssef, N. (1971). Social Structure and the Female Labor Force: The Case of Women Workers in Muslim Middle Eastern Countries. Demography 8(4): 427-439.